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Petroleum Refiner

APRIL
1957

NATURAL GASOLINE DEVELOPMENTS
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NEW METHOD
How to Find Tube Sheet Diameters...194

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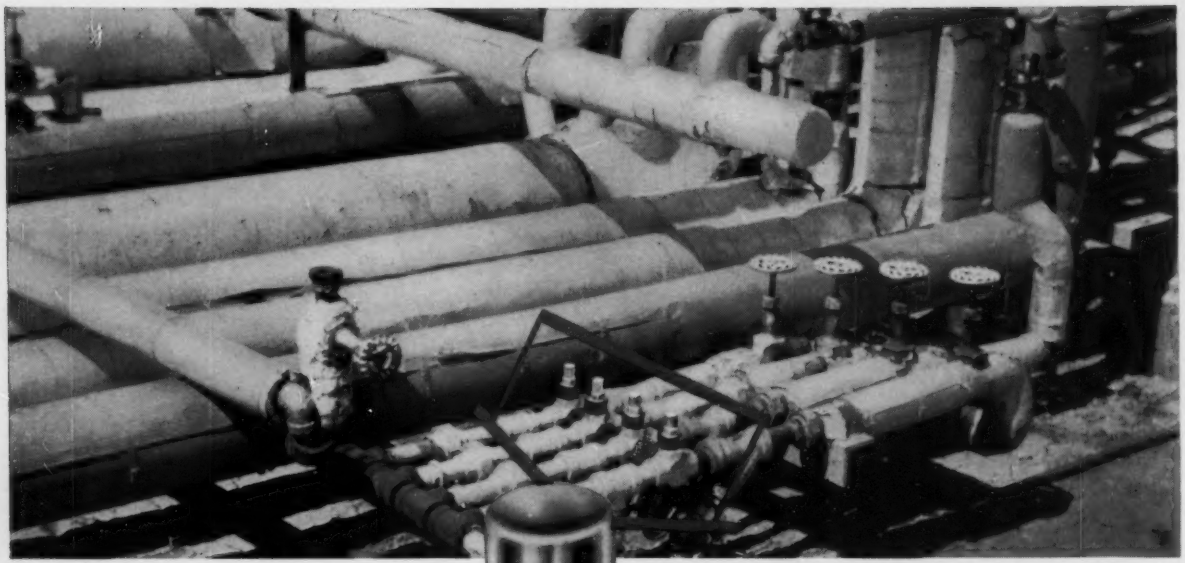

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Petroleum
Refiner
REFINING • PETROCHEMICALS • NATURAL GASOLINE

A Quick Look at This Issue

These handy digests permit checking those articles you want to read first.

A SPECIAL REPORT ON NATURAL GASOLINE

☐ **Automated Gasoline Plant of 1975 . . .** Take a look at what's expected in the radical control systems for gasoline plants of the future. Though the plant's external appearance may not look much different, you can expect plants to take the four steps to automation outlined in this article on Page 132.

☐ **How to Get Along With Producers . . .** Since natural gasoline operators are middlemen between customer and producer, it helps us a lot if we give the producer as good service as the customer. You'll find five rules in this article for bettering these relations and how to set up a program for the future. Turn to Page 140.

☐ **Adsorption—The Process to Watch . . .** A 40-bpd unit recently has been developed and tested. It shows an attractive payout for charging small volume, lean gas. It could meet the urgent need for a recovery process in this range. To see how it works, turn to Page 141.

☐ **Why Dorchester Will Add Catalytic Reforming . . .** To its White Deer gasoline plant, Dorchester will add a 1000-bpd Unifiner-Platformer combination. This investment will keep Dorchester in the motor fuel business in the face of declining prices for higher-boiling liquid products. Economics in this article show a payout of 1.3 years. Turn to Page 146.

☐ **Underground Storage Cuts Costs 90 Percent . . .** Atlantic cut LPG storage costs at its Denton gasoline plant with two salt cavities. So far, cost per barrel of storage is $2.15 but could be reduced to $1 with more washing. Here's how they went about developing the storage. Turn to Page 149.

☐ **How Safe Is Your Gasoline Plant? . . .** Design and operation of a safe natural gasoline plant is the responsibility of management—and the

Please Turn Page ➔

A Quick Look at This Issue . . .

technical man. What are their safety responsibilities? How can they be met? For the answers to these and other timely questions concerning plant safety, turn to **Page 152.**

☐ **Better Stripping and Absorption Factors . . .** The series of charts presented here will save time and make for more accuracy in tower evaluation. Average factors differ from others because they are based on a geometric gradient. This article covers wide range of conditions. Turn to **Page 153.**

☐ **South Hampton Steps Up Platformer . . .** To its existing catalytic reformer installation, South Hampton Company is adding prefractionation facilities to increase production. The plant will now be able to take a 1200 bpd charge versus existing 700 bpsd. This operation is one of the few but growing instances where a standard catalytic reformer has been installed apart from a refinery. Turn to **Page 161.**

☐ **Cooling Water Corrosion . . .** There are just two important variables when you approach this problem—conductivity and size of anodic and cathodic areas. This article shows why these are the two factors that should be considered in inhibiting cooling water. Turn to **Page 164.**

☐ **How Phillips Sets Up Preventive Maintenance . . .** This program in the Natural Gasoline department of Phillips can be justified in downtime savings alone. It also reduces hazards of equipment wrecks. You'll find in this article the eight factors that are considered. Turn to **Page 166.**

☐ **New Concept in Polymer Chemistry . . .** Duplication of the ordered arrangement of natural polymers gives a clue to their ideal physical properties. New families of catalysts have produced stereospecific polymers of various kinds. These polymers are of practical and theoretical importance. Here is background and nomenclature to supplement your polymer chemistry file. Turn to **Page 169.**

☐ **Optimum Operations for Octanes . . .** Champlin uses a digital computer to establish the best operations for their refining processes. To learn of some of the factors they consider in minimizing the cost of making a given octane motor fuel, turn to **Page 172.**

☐ **Fluid Catalyst Design Data (Part 1) . . .** You must understand the properties of bulk solids if you are to design solids handling equipment associated with fluid catalytic units. Here the commonly observed characteristics of powders, sands and granular solids in general are correlated with specific, experimentally measured, pseudo-physical properties. This is a must for your design work book. Turn to **Page 173.**

☐ **Find Catalyst Density With Isotopes . . .** Knowing the distribution of catalyst in a fluid catalytic cracking unit can lead to better operation. Now the catalyst distribution inside the vessels and transport lines can be determined while operating at high temperatures with a gamma-ray absorption techniques. This step-by-step procedure is explained and actual results plotted. Apply this new method in your research program today, turn to **Page 173.**

☐ **Examine Solvent Dewaxing . . .** This is the second and last part of the informative series on dewaxing. A method is described which permits solvent dewaxing problems to be studied with the aid of triangular graph paper. **Page 183.**

☐ **Automation Today—Part 10 . . .** In previous parts of this series, a discussion was given for each component of a control loop. Now the author applies these principles to a process which consists of a chemical reaction. To see how to apply these principles to your reactions, turn to **Page 187.**

☐ **How to Stop Corrosion Under Insulation . . .** Here are reports from actual experiences that will give you the problems encountered, the remedial measures taken and a suggested specification for the insulation of piping and equipment. For complete details, turn to **Page 192.**

☐ **How To Calculate Tube Sheet Diameters . . .** Here's a simple method that does not involve tabulated values, approximations or educated guesses. For complete information, turn to **Page 194.**

☐ **Easy Method To Get Beam Deflection (Part 3) . . .** Here's an easy way to solve those beam problems involving applied couples and restrained beams. For complete details, turn to **Page 199.**

☐ **Easy Method of Stanchion Design . . .** If you are troubled with solving fourth degree equations, here's a way to eliminate that tedious textbook method. See **Page 201.**

☐ **Do Your Own Calculations on Steam-Flash Vaporization of Multicomponent Mixtures . . .** with this new and advanced method. Even though these equations are for complex systems they are surprisingly easy to apply. You will see by the illustrative examples how simple it is to make these calculations. **Page 203.**

☐ **Centrifugal Pump Packings and Seals (Part 3) . . .** Here's a complete discussion on mechanical seal application so that you will know which type to use and where. Turn to **Page 207.**

☐ **How To Develop Leaders . . .** One of the most successful programs for the selection of executive and management people has been the individual method of appraisal, training and development. For a complete outline describing ways to perfect this proved technique, turn to **Page 264.**

☐ **How To Prevent and Extinguish Floating Roof Tank Fires (Part IV) . . .** What causes floating roof tank fires? What type of floating roof tank is the least conducive to fire? What is the most effective way to fight these fires? Answers to these and many other questions regarding floating roof tank fires are given by one of the nation's top authorities on fire protection. Turn to **Page 278.**

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PETROLEUM REFINER and The REFINERY CATALOG for the refining, natural gasoline, petrochemical industry.

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Behind the Scenes

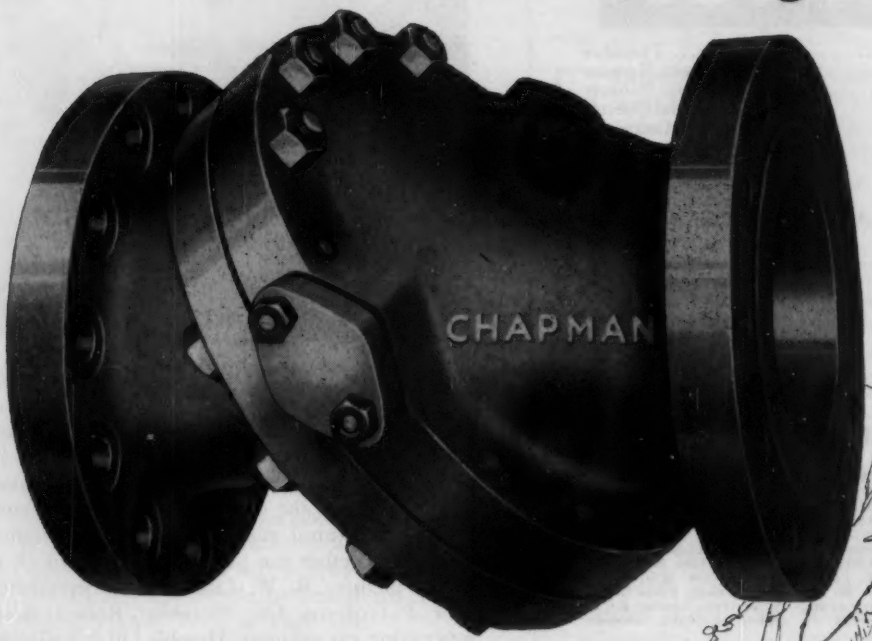
THOUGH PR's EDITORS have all worked in industry, we go a step further to be sure that our special reports are accurate and in tune with the reader's needs. Industry experts are invited in for conference when a special report is in the planning stage. Such was the case with the special report this month on natural gasoline. Back in November, we gathered together the industry men shown (l. to r.) in the picture: R. W. Linehan, vice president, Anchor Petroleum Co., Houston; Robert Rosewall, supervising gas engineer, Humble Oil & Refining Co., Houston; John Sue, consultant, Coastal Transmission Corp., Houston; and J. N. Chancellor, plant engineer, Pan American Petroleum Corporation, Alvin.

They helped us plan this special report so that it would be of most interest to readers. The attendance by industry guests to such conferences does not constitute an endorsement of PETROLEUM REFINER over any other one publication. Rather, the fact that men of outstanding ability attend these planning conferences shows the interest which the oil and petrochemical industry has in sound editorial content planned for the benefit of the industry and for those who work in it.

How Catalysts Behave

AN UP-TO-DATE ORIENTATION and appraisal of recent developments resulting from studies in fluidization, prepared by Frederick A. Zenz is commencing in this issue, Page 173. PETROLEUM REFINER readers are getting a series that will prove of great value. The eight articles will incorporate the chief aspects of fluidization and orient this unit operation with the general subject of fluid-solid behavior in simpler, related fields. The articles are slanted, of course, toward the petroleum industry and particularly fluid catalyst and moving bed operations. Author Zenz, pretty well known for previous PETROLEUM REFINER contributions, has had 14 years of varied process and development experience in the industry; so he speaks with real authority. Like many another REFINER article, Zenz No. 1 as well as the other seven make excellent reference material.

First with Floating Power



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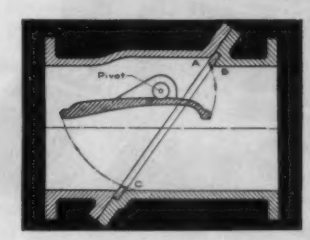
For handling fluids or gases under a wide range of pressures, always specify Chapman Tilting Disc Check Valves. They're available in iron or steel. Explained in full in our Catalog 30-A. Yours for the asking. Write.



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

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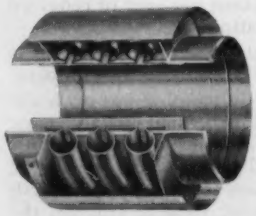

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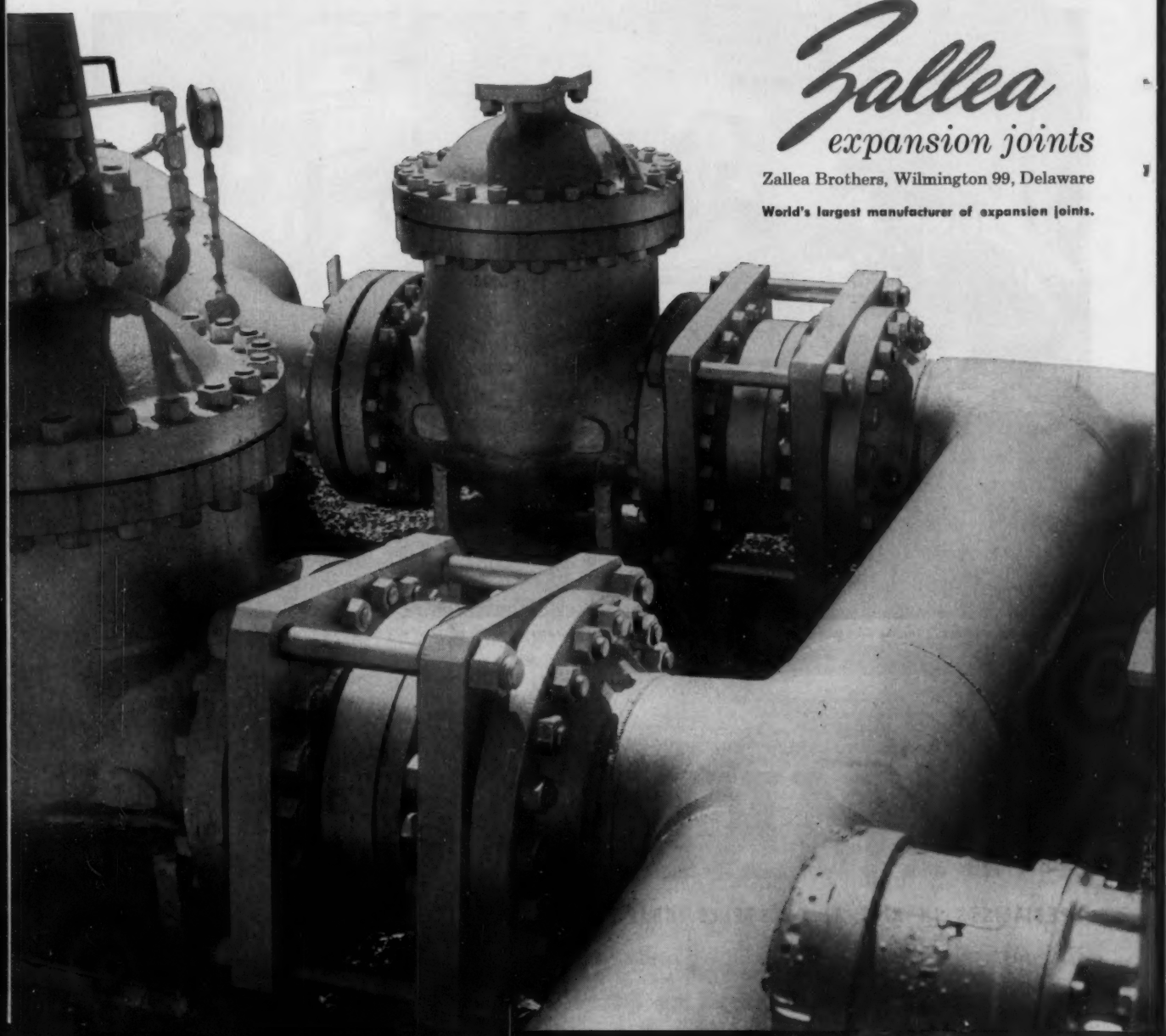
*Patented



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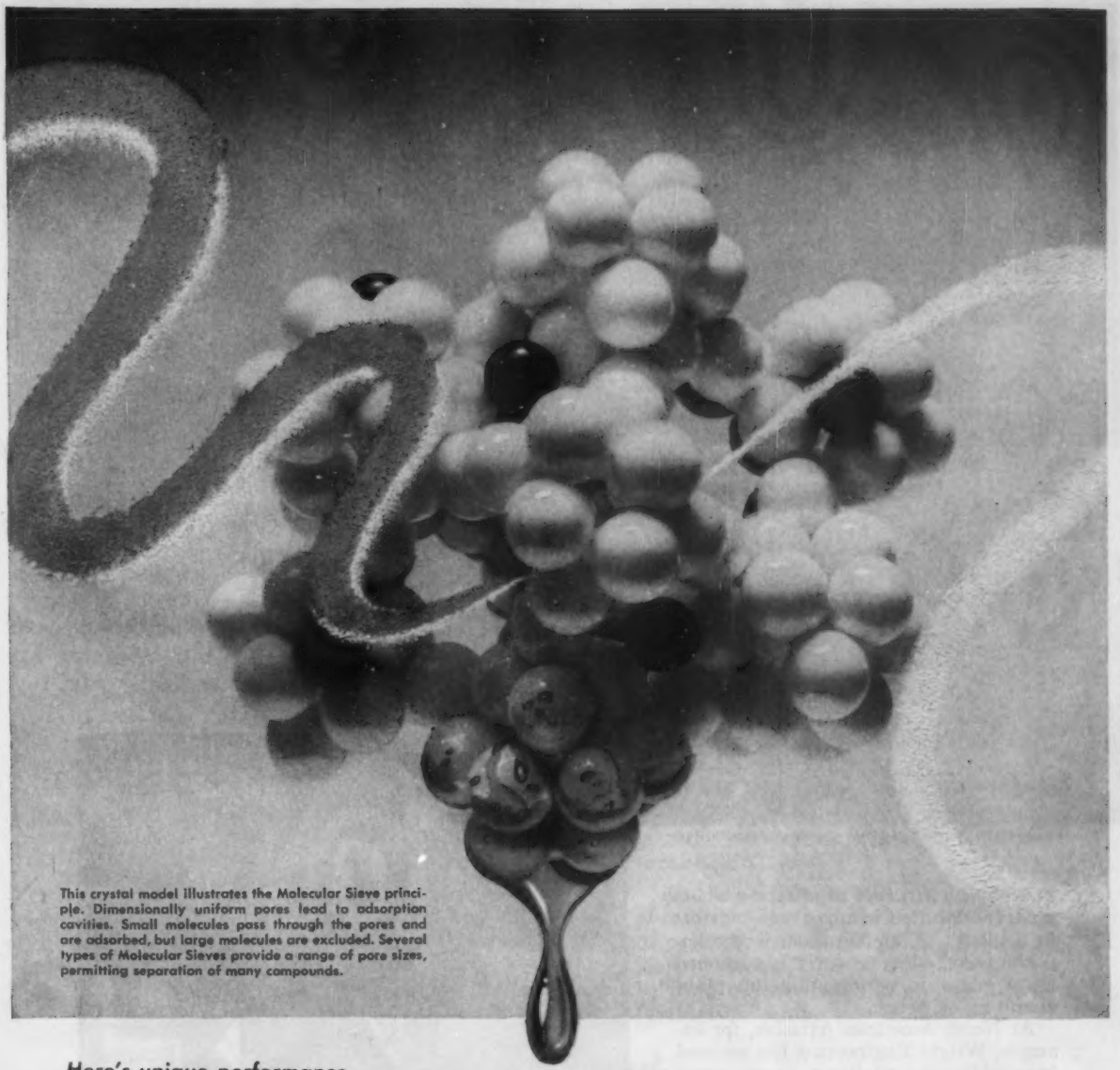

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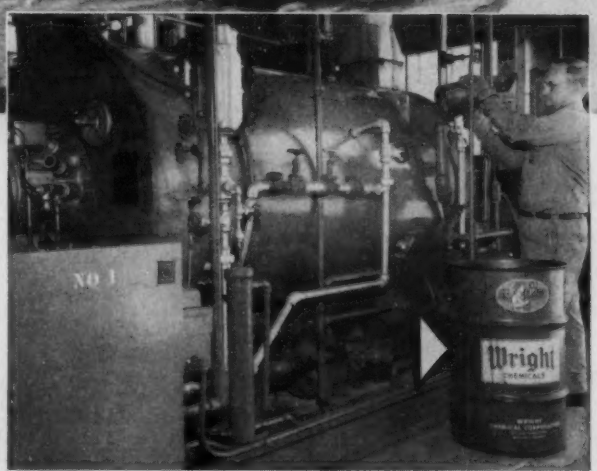

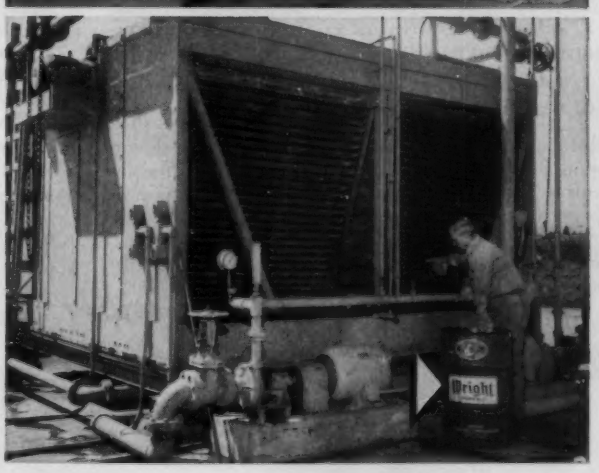

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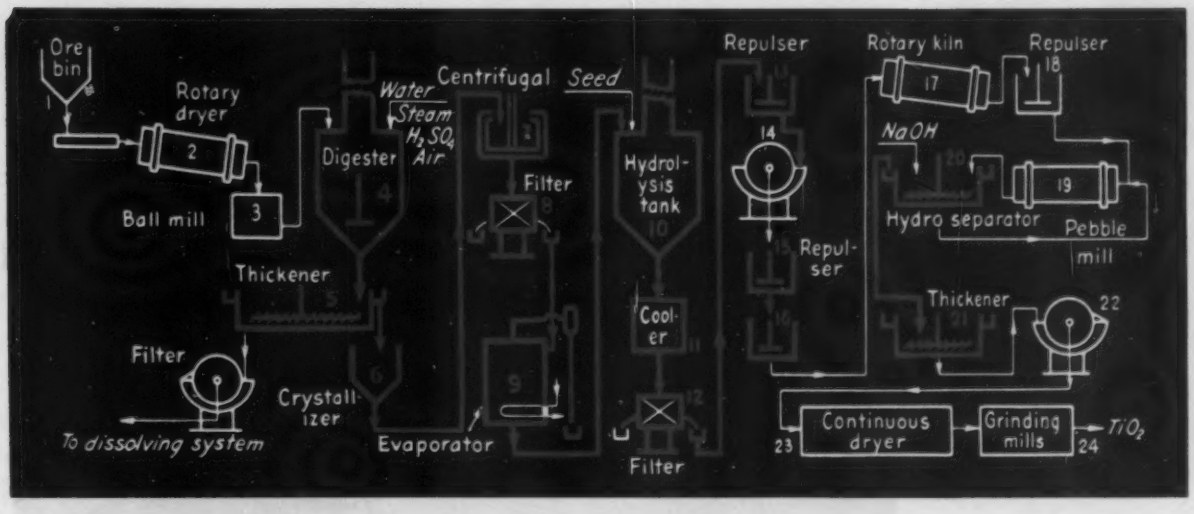


HOW *lead is used to control corrosion*

in Titanium Dioxide Production Equipment

TiO_2 is not corrosive. But H_2SO_4 is a real metal-eater . . . *first* on the attacking line in the production of TiO_2.

First on the defensive line, however, is *lead*, dependability itself when it comes to combating many corrosive chemicals.

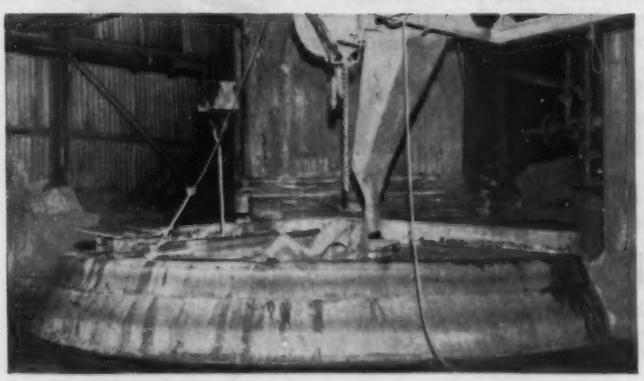
Lead reacts on contact with H_2SO_4 and other "corrosives" to form an insoluble, impermeable film. This film adheres to the metal surface . . . stopping or slowing down further reaction or attack.

Starting with digesters, where ilmenite ore is treated with sulphuric acid, *lead* is a steady defender . . . as lining for vessels and tanks, valves and pumps, in heating and cooling coils, in centrifugals and filters. It is used in combination with steel, concrete, wood or brick in many of the steps in the manufacture of TiO_2.

And bear this fact in mind: the use of *lead* cuts down-time. *Lead* lends itself to prompt, low-cost repairs. In case of leak or lesion, the affected area may be fixed quickly, with minimum loss of production. And . . .

. . . when you think of Lead . . .

think of National Lead

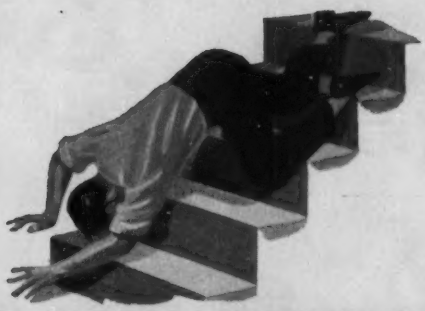


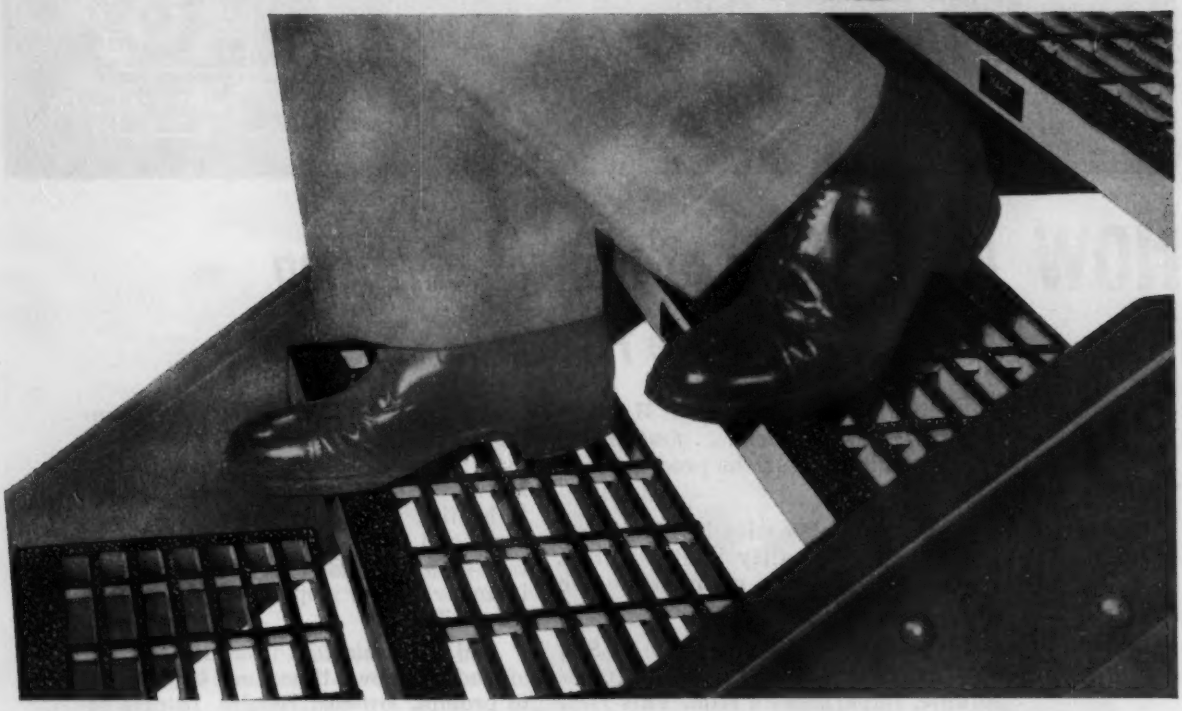
National Lead's long experience in bringing *lead* and steel together . . . in acid-handling lines, in complex, massive process, storage and shipping vessels . . . is at your service. When *lead* and steel are bonded together in this equipment, the union is stronger than *lead's* tensile strength. Cracking of the lining, due to vibration, pressure and rapid cyclic temperature changes, is held to a minimum. Creep is virtually eliminated.

Perhaps *lead* can save you money. Contact National Lead Company, Lead Lined Products, 111 Broadway, New York 6, N. Y., for information.

For more data on advertised products, use Readers' Service Cards, last page.

Eliminate slipping accidents!





Relgrit Abrasive Embedded Grating Treads

Industrial plants throughout the country have found that Relgrit has practically eliminated slipping accidents wherever used.

Relgrit treads are made with an aluminum oxide abrasive, embedded in a "V" groove at the top of the grating bars and nosing. This forms a skid-proof surface that is virtually immune to wear; providing *permanent* protection from slippery surfaces due to water, mud, oil, grease, acids and chemicals. Relgrit is also made for platforms and all other grating areas.

You can't slip on Relgrit

For above FREE SAMPLE and Literature—write to Dept. B

RELIANCE STEEL PRODUCTS COMPANY

McKeesport (Pittsburgh District) Pa.

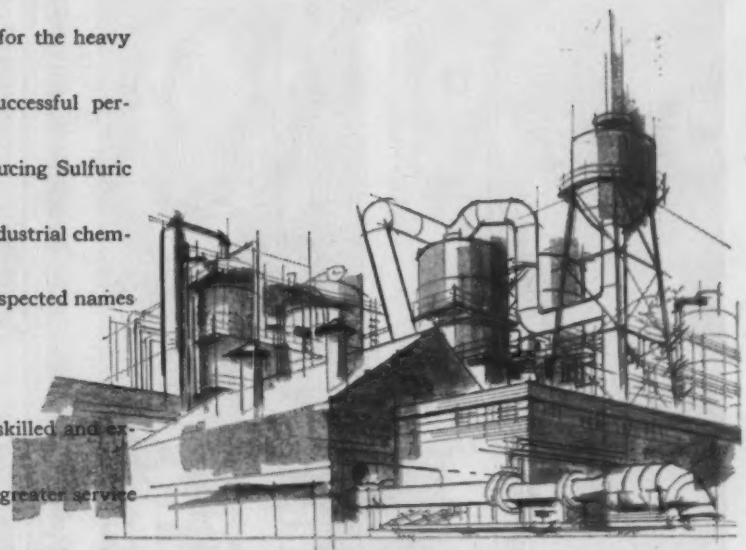
Offices and Agencies throughout the country

Relgrit Grating Bridge Flooring

an old name in Chemical Engineering...

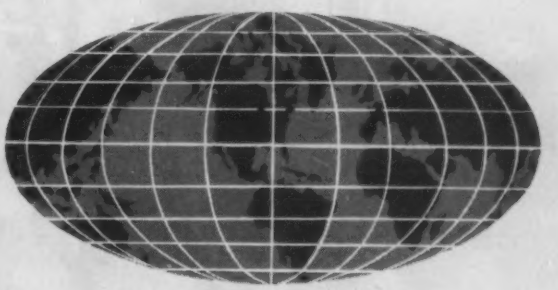
now a new member of the ELECTRIC BOND and SHARE Family!

For more than 42 years Chemical Construction Corporation has been building plants all over the world for the heavy chemical and petrochemical industries. The successful performance of these CHEMICO plants — producing Sulfuric Acid, Ammonia, Urea, Acetylene and other industrial chemicals — has made Chemico one of the most respected names in chemical engineering.



Now, under new ownership, Chemico's skilled and experienced engineering staff can provide even greater service in the design and construction of plants and in the development of new processes.

If you are considering the expansion, development or diversification of your production facilities, call on Chemico for efficient and economically-sound planning.



CHEMICO

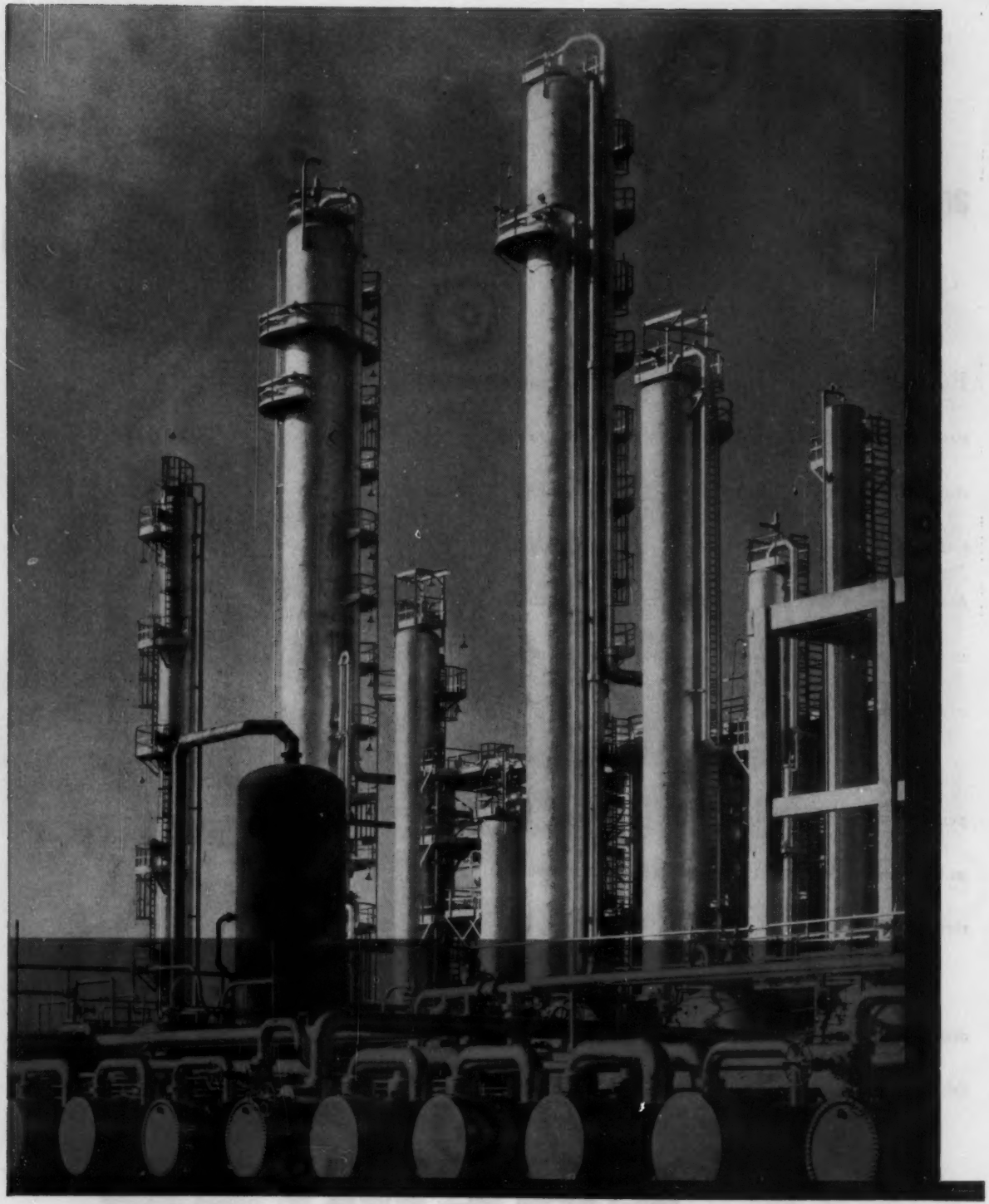
CHEMICAL CONSTRUCTION CORPORATION

A SUBSIDIARY OF ELECTRIC BOND AND SHARE COMPANY

525 WEST 43rd STREET, NEW YORK 36, N.Y.

Cable Address: CHEMICONST, New York—Telephone: LOngacre 4-9400
Chicago • Dallas • Portland, Ore.
Affiliated Company: Chemical Construction (Great Britain) Ltd., London, England
Representatives in Johannesburg, Paris, Tokyo

For more data on advertised products, use Readers' Service Cards, last page.



FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!

For dependable "on-stream" performance...
retube your exchangers with

PHELPS DODGE HEAT EXCHANGER TUBES!

Wide selection of copper-base alloys for every type of application—including bi-metal combinations.

Complete warehouse stocks maintained at Houston, Texas; Tulsa, Okla.; Los Angeles, Cal.; Chicago, Ill.; and Bayway, N. J.

Expert assistance in solving your tube corrosion problems.

Specify Phelps Dodge... One of the largest suppliers of tubes to manufacturers of heat exchangers!

PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

For more data on advertised products, use Readers' Service Cards, last page.

Peppermint and spearmint oils must be kept pure to insure uniform flavor. That's the chief reason why I. P. Callison & Sons, Inc. of Seattle changed from coated steel drums to Benson Aluminum Drums for shipping these expensive oils. They believe, "It will only be a matter of time before the industry adopts aluminum as a standard for drum packaging".

Because aluminum resists corrosion there is no metal coating inside aluminum drums . . . nothing to flake off and contaminate the oils.

And aluminum drums offer economy. Aluminum's strength helps them withstand greater shock in handling and shipping. Aluminum's light weight provides substantial freight savings. And aluminum drums are easier to clean for re-use.

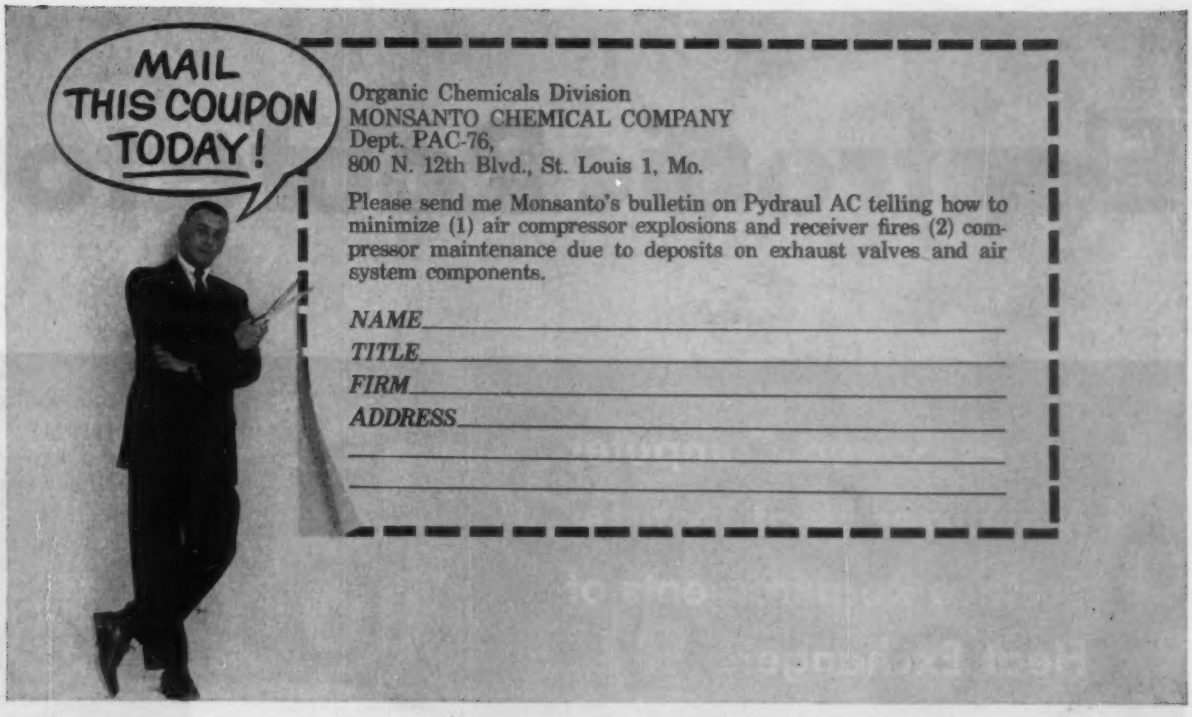
For further information about proven benefits of Benson Aluminum Drums, contact the Reynolds office listed under "Aluminum" in classified telephone directories or write *Reynolds Metals Company, P. O. Box 1800-CT, Louisville 1, Kentucky.*

See "CIRCUS BOY", Reynolds exciting dramatic series, Sundays on NBC-TV.

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

REYNOLDS ALUMINUM

For more data on advertised products, use Readers' Service Cards, last page.



Organic Chemicals Division
MONSANTO CHEMICAL COMPANY
Dept. PAC-76,
800 N. 12th Blvd., St. Louis 1, Mo.

Please send me Monsanto's bulletin on Pydraul AC telling how to minimize (1) air compressor explosions and receiver fires (2) compressor maintenance due to deposits on exhaust valves and air system components.

*NAME*_____

*TITLE*_____

*FIRM*_____

*ADDRESS*_____

Want to reduce fire hazard in your air compressors?... Read Monsanto's bulletin on Pydraul AC

When flammable oil mists and films gather in your compressed air system... you have a real fire risk!

Ease your mind—there's a new, fire-resistant lubricant to protect your equipment, your workers and your production flow from compressor fires and explosions caused by flammable oils. Simply replace your ordinary petroleum oils with fire-resistant Pydraul AC compressor lubricant.

Pydraul AC is chemically made, not a water-soap base mixture, not a petroleum oil. It's a completely new type of bearing-protecting lubricant. Pydraul AC is created especially for air compressors. With Pydraul AC lubrication you ease your mind about compressor fires and explosions. You may also reduce maintenance costs because Pydraul AC can minimize carbon deposits on air compressor exhaust valves and air piping systems.

There's no conversion problem—just drain out the flammable lubricant and replace with fire-resistant Pydraul AC—it's that easy!

For more facts—fast: Just mail the coupon today for the new Monsanto bulletin on Pydraul AC. No cost to you. It shows properties, field experience, operating economies, etc. Act *now*. Mail coupon *today!*

There's also a fire-resistant Pydraul for every industrial hydraulic job:

- General-purpose Pydraul F-9
- Pydraul 150 and Pydraul 60 for precision equipment
- Pydraul 600 for heavy equipment

PYDRAUL: Reg. U. S. Pat. Off.

MONSANTO

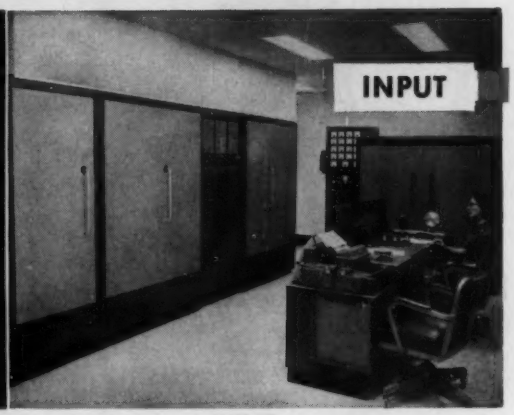
MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Dept. PAC-76, 800 N. 12th Blvd., St. Louis 1, Mo.

Where Creative Chemistry Works Wonders For You

For more data on advertised products, use Readers' Service Cards, last page.

Electronic Route to

Super-Speed Computer Minimizes Heat Transfer Surface Requirements of Heat Exchangers . . .



Control section of Kellogg's computer

IN DESIGNING heat-pressure process equipment, the addition of a large magnetic drum digital computer to M. W. Kellogg's facilities enables the company's engineers to study variables and produce results with unprecedented thoroughness, accuracy, and speed. Human error is practically eliminated.

To Kellogg's customers in the petroleum and chemical industries, this new electronic aid means that Kellogg engineers can devote more time to basic design problems, and provide equipment with maximum operating efficiency, minimum maintenance costs, and the lowest possible initial investment.

In the case of heat exchangers, for example, design calculations require a trial and error solution. The time required to do this with hand calculations seldom permitted several design alternates. Thus the engineer never could be sure that the design selected was the true optimum. With high speed electronic computation, however, the greater number of alternates economically possible now brings the ultimate or near ultimate design to every Kellogg customer.

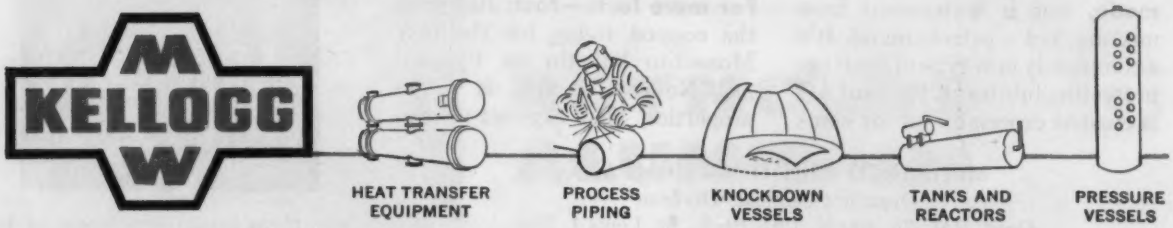
In one instance recently, involving 37 heat exchanger shells, the greater number of calculations achieved with the electronic computer resulted in reducing total heat transfer surface requirements by more than 15% from estimated values. Without the computer, the time required to obtain this value would have outweighed the saving many times, and would have been prohibitive.

Kellogg welcomes the opportunity to put its electronic computer and other engineering facilities to work for you. Arrangements to see the computer in operation in Kellogg's New York office can be made by contacting the company's Fabricated Products Division.

Fabricated Products Division • THE M. W. KELLOGG COMPANY • 711 Third Avenue, New York 17, N. Y.

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corporation, London • Societe Kellogg, Paris
Kellogg Pan American Corporation, New York • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas



For more data on advertised products, use Readers' Service Cards, last page.

Optimum Designs

Estimate Shell Size and Arrangement

Tube Side Arrangement
Tube Passes, Critical Temperatures, Velocity

Shell Side Arrangement
Shell Passes, Baffles, Velocity, etc.

Preliminary Performance Evaluation
MTD and Heat Transfer Resistances

Final Performance Evaluation
MTD, Resistances of Each Zone and Shell

Modify Design
Parallel series arrangement
Tube Passes
Shell Passes
Shell Size

Examine Performance and Design
Reject
Accept

PRINT OUT

HEAT EXCHANGER

ITEM NO & TYPE	75614	0		
ARRANGEMENT SERIES PARA	2	0		
SURFACE TOTAL PER SHELL	2179	35260	1089	67630
TOTAL FLUID 1000 LBS HR	148	00000	371	00000
SP GRAVITY LIQUID		87620		87620
TEMP VISCOSITY F CS A	53130	01306	53130	01706
TEMP VISCOSITY F CS B	53300	01102	53300	01205
TEMPERATURE HOT	300	00000	350	00000
TEMPERATURE COLD	130	00000	266	00000
TUBE PASSES PER SHELL		00000	2	00000
PRESS DROP ALLOW PSI	10	00000	15	00000
PRESS DROP CALCD PSI	9	96988	11	26021
FOUL RESIST & TUBE DIAMTR		00004	1	00000
DUTY MM BTU HR & MTD RTD	13	30000	87	64713
TOTAL RESIST SERVICE CALCD		01436		01163
DESIGN PRESSURE PSI	150	00000	300	00000
TUBE NUMBER AND LENGTH FT	212	42078	20	00000
SHELL INS DIAM BAFF PITCH		1100	8	61250

This liquid-liquid heat exchanger design flow sheet shows the route taken by Kellogg's electronic computer to obtain optimum design results. The boxes shown at right indicate the paths taken by the machine in arriving at the solution. Photograph at right is of a partial tabulation, showing how the computer presents results.

For more data on advertised products, use Readers' Service Cards, last page.

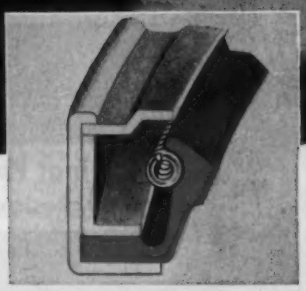
MORE OF THE GARLOCK 2,000

Will not **CRACK** *or* **HARDEN**
at high and low temperatures.

Garlock Silicone Rubber KLOZURE* *Oil Seals*

retain their original properties even after long exposure to temperature extremes that would quickly ruin organic rubber.

They are flexible and serviceable at temperatures as low as —90° F, and as high as 500° F . . . ideal for seals on automotive and aircraft products.



***Klozure Oil Seal with Silicone Sealing Element** for high speed, high temperature applications such as transmission cases, diesel engine crankshafts, and aircraft accessory gear cases. (Model 65 illustrated.)*

Extrusions and molded parts of Silicone Rubber are only part of "The Garlock 2,000"... two thousand different styles of packings, gaskets, and seals to meet all your needs.

It's the *only* complete line . . . that's why you get unbiased recommendations from your Garlock representative. Call him today or write for Oil Seal Catalog No. 20.

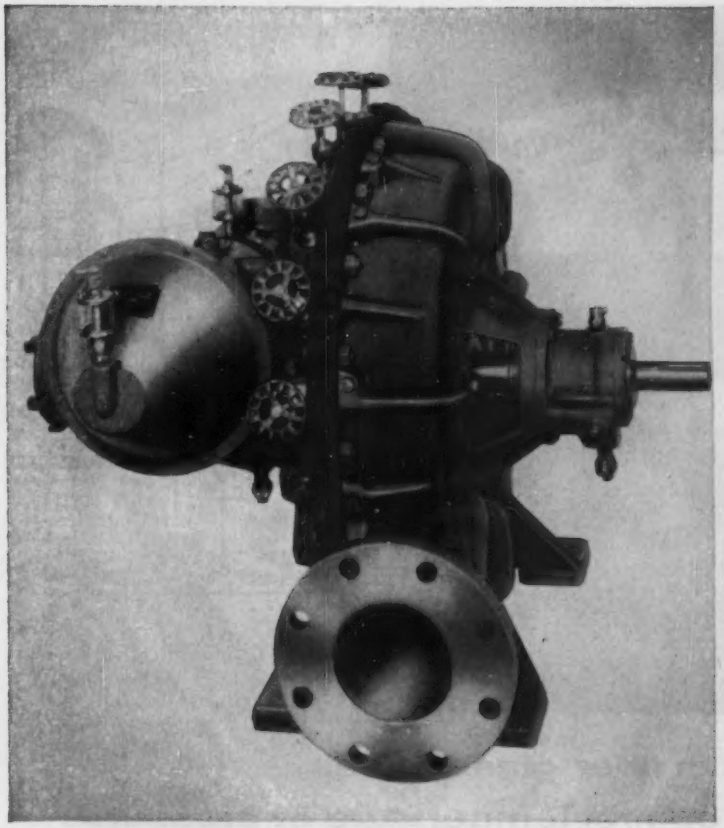
THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, *contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.*

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

**Registered Trademark*



This is the reliable Coppus Turbine furnished with either type of wheel

Wide bucket "L" type wheel

Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

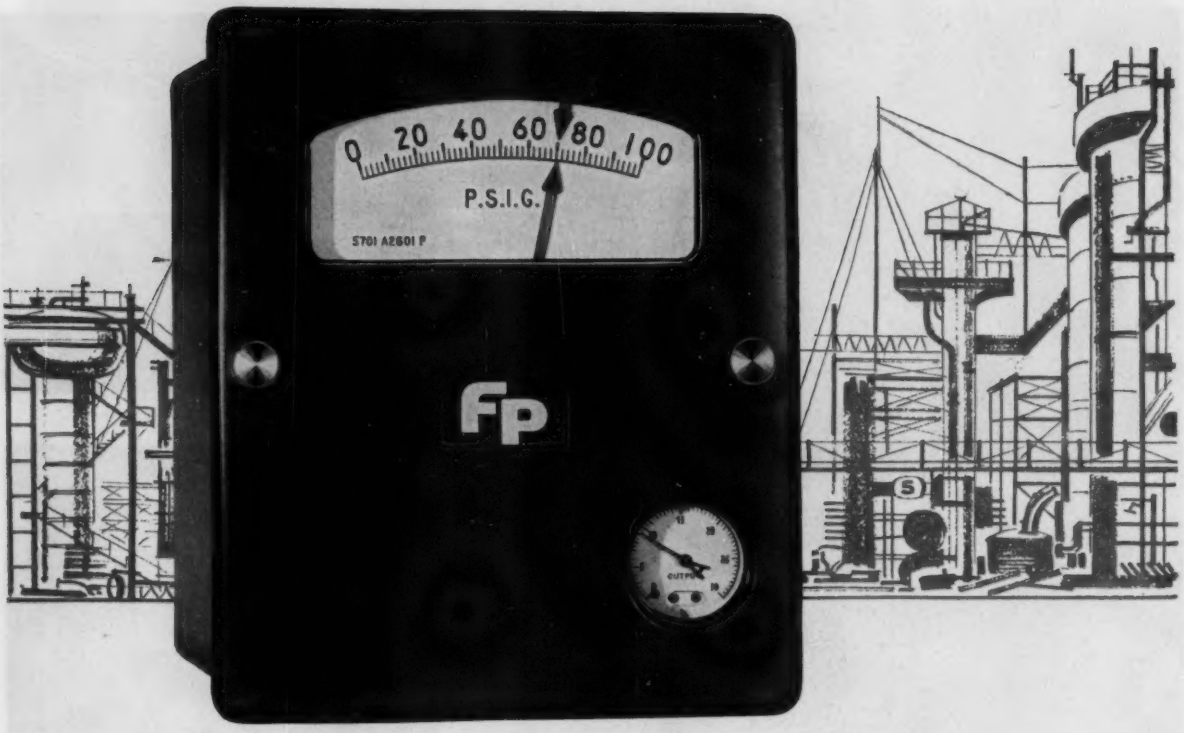
- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION
417 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

For more data on advertised products, use Readers' Service Cards, last page.



new small instruments in fiber glass cases indicate . . . transmit . . . control temperature or pressure

NOW . . . instruments as corrosion-resistant as the equipment they control! Every instrument in Fischer & Porter's new 1450 Series is housed in a fiber glass reinforced polyester case resistant to acids, alkalis, salts, solvents, dust, and weather. You can place indicators, transmitters, and controllers wherever you want—inside or out—without regard for corrosive fume and splash. The protection is built right into the housing . . . nothing to wear away or scratch off . . . no coatings to renew. The first such equipment available for process instrumentation, Series 1450 brings a new flexibility and freedom to instrument installation.

There's no way for corrosive atmospheres to reach the working instrument. Every exposed part is either plastic or 316 stainless steel. And a polyvinyl chloride gasket provides a positive seal against dust and moisture entry.

F&P has engineered the unique new 1450 Series housing for operation and maintenance ease. The entire instrument can be removed from the case if desired. Zero adjustment and range changes are easy. A plug in the removable door provides access to the adjustment screw for the optional external set point.

Field tested over a one year period, the 1450 Series is available NOW on four week delivery schedules.

SERIES 1450
CORROSION-PROOF INSTRUMENTS

Temperature Range:

minus 400F to plus 1000F.

Pressure Range:

30" Hg vacuum to 5000 psi
As pneumatic receivers, 1450 instruments accommodate 3 to 15, 3 to 18, or 3 to 27 psi signals.

Instrument Options:

Single indicator • dual indicators • single indicator with dual alarms • indicating controller with any mode of control • indicating transmitter. Transmitter can provide pneumatic outputs, resistance outputs, or differential transformer outputs.

Controller Options:

- universal controller with on-off, proportional, differential gap, and manual reset
- wide band proportional
- wide band proportional plus automatic reset
- wide band proportional plus automatic reset plus derivative

Mounting:

Suitable for surface, pipe, or panel mounting. Panel cutout size is 8¾" x 10¼".

For complete data write Fischer & Porter Co., 947 County Line Road, Hatboro, Penna.

FISCHER & PORTER CO.

Complete Process Instrumentation

Check with **CHASE**®

for longer lasting

HEAT EXCHANGER TUBES

It pays to know *all* about Chase Antimonial Admiralty Heat Exchanger Tubes. How precision alloying virtually eliminates failures from dezincification. How controlled annealing assures freedom from season cracking. How rigid quality controls safeguard your investment. Yes, it pays to know about Chase! Pays off in lowered operating costs...fewer breakdowns...more time between replacements! Find out! Check with Chase today! Write for your free 54-page manual: *"Chase Condenser and Heat Exchanger Tubes."*

Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

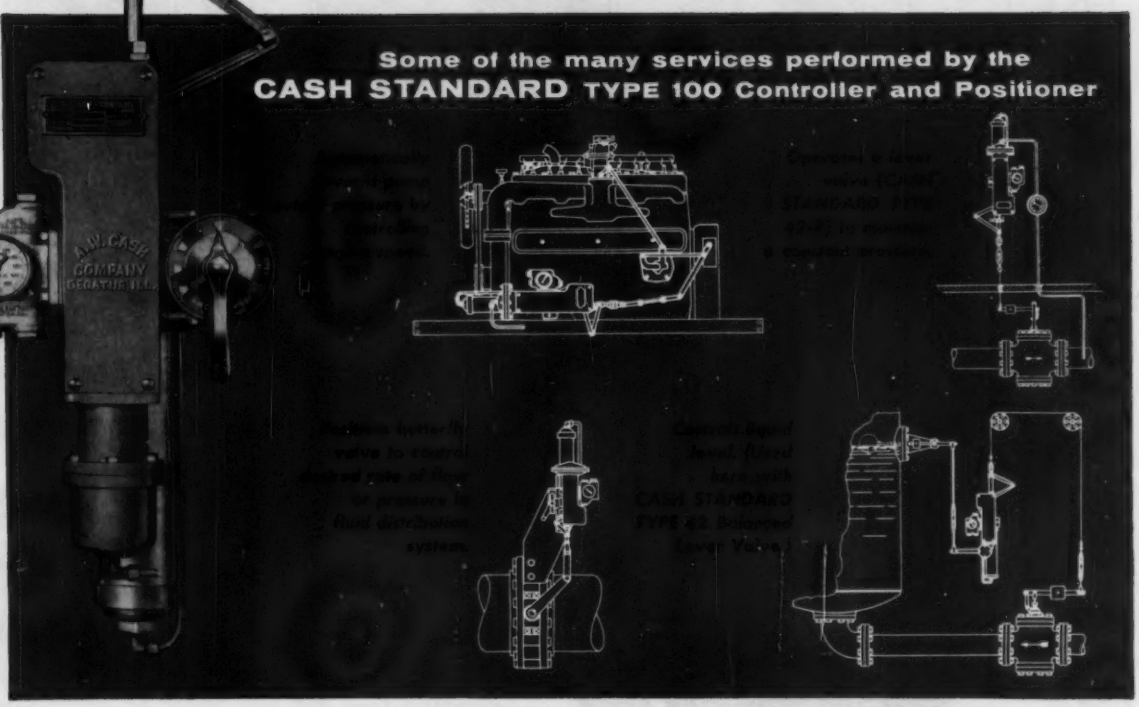
Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L. I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

For more data on advertised products, use Readers' Service Cards, last page.

automatic control or positioning problem?

Here's the answer... the versatile

CASH STANDARD
Type 100
Controller and Positioner



include this unit in your process system as:

1. A controller with self-contained positioning mechanism.
2. A power positioner actuated by a signal from another controller.

The Type 100 coupled with various types of final control elements will accurately control:
• Pressure • Liquid level • Rate of flow • Other process variables

The Type 100 features: • Feed back type control • Adjustable range • High sensitivity • Linear or curved line characteristics • Reverse or direct action • Optional manual control • Double acting cylinders, 6″ or 12″ stroke, 2″, 2¾″ or 4″ bore for operating pressures up to 125 psi. (Also suitable for larger cylinders in combination with volume booster when higher thrusts are desired.) • Operation by air, oil or clean water.

Available for these signal ranges: • Vacuum • Differential pressure • Pressures up to 600 psig. • Lever motion

WRITE TODAY for complete information, including literature, on this versatile instrument. Dept. L.

CASH **STANDARD**

A. W. CASH COMPANY, P. O. Box 551, Decatur, Illinois

Pressure, Hydraulic, Temperature, Process and Combustion Controls

...your low-cost key to high octane

Atlantic's Catalytic Reforming Process continues to prove its ability in giving superior results on a broad variety of feed stocks. Catforming's simplicity brings savings through increased efficiency every step of the way—actually eliminating many profit-robbing intermediate steps.

Regardless of the volume of your charge stock, Catforming deserves your attention. One major reason that Catforming has "proved out" commercially is attributable to Atlantic's broad experience in all phases of petroleum refining and processing.

We invite your inquiries on Catforming. Write or wire The Atlantic Refining Company, Research and Development Dept., P.O. Box 8138, Philadelphia 1, Pa.

ATLANTIC

it's the CATALYST that counts

For more data on advertised products, use Readers' Service Cards, last page.

throughout the world...

A. P. GREEN

Serves the Petroleum Refining Industry with a Complete Line of High Quality Refractory Products

The petroleum industry throughout the world, relies on A. P. Green high quality refractories for dependable service in thermal and catalytic cracking units, heaters, boilers, stacks, et cetera.

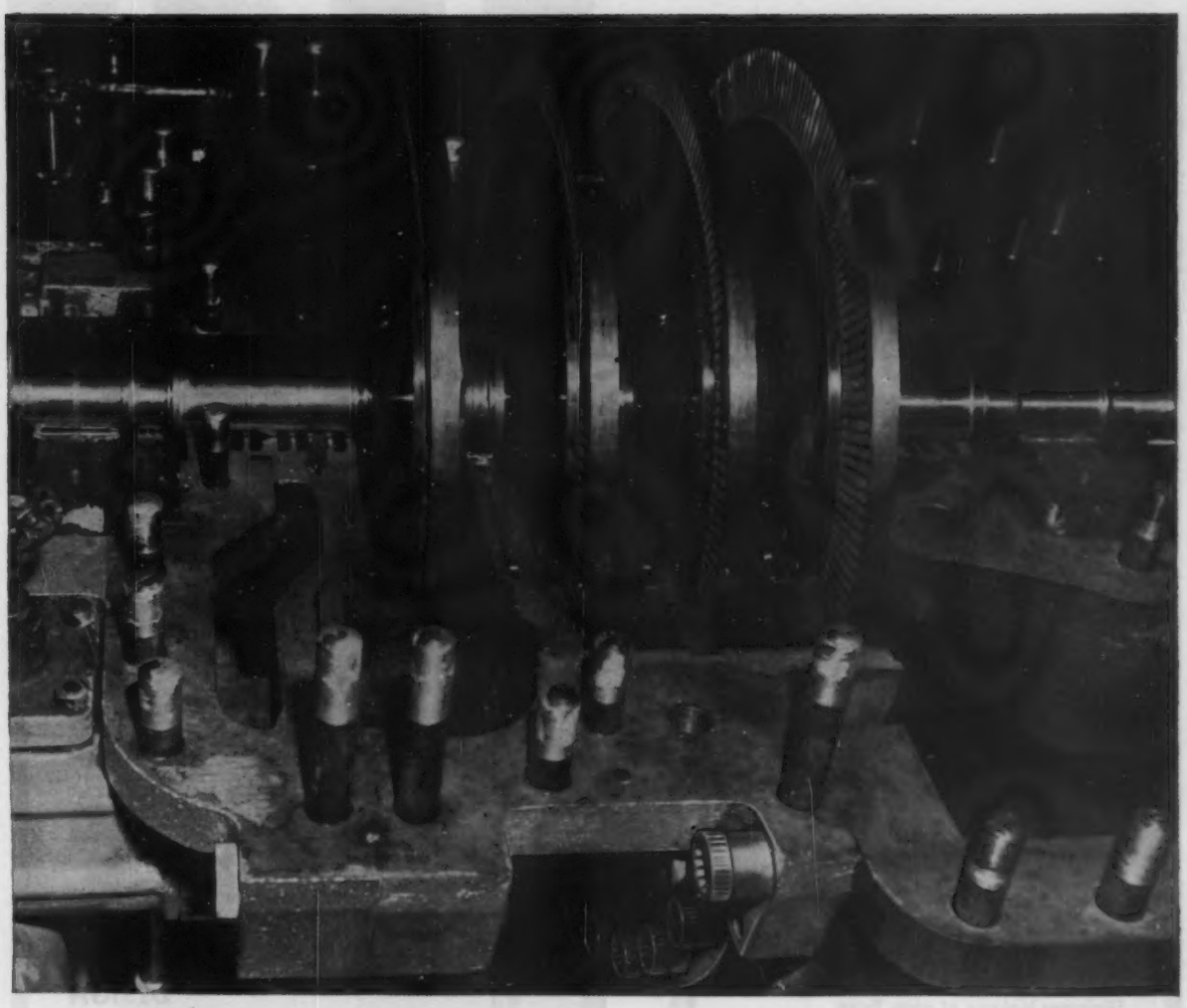
A world-wide network of A. P. Green distributors with engineers experienced in petroleum refining is always ready to help you select the right refractories to do the best possible job . . . at the lowest cost. For one dependable source of a complete line of refractories write . . .

A. P. Green REFRACTORY PRODUCTS

Distributors in the Principal Cities of the World

A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

PLANTS: Mexico, Mo. • Woodbridge, N. J. • Sulphur Springs, Texas Jackson, Oak Hill, South Webster, Ohio • Philadelphia, Pa. • Troy, Idaho
In Canada: **A. P. GREEN FIRE BRICK COMPANY, LTD.** Toronto 15, Ontario
In England: **LIPTAK FURNACE ARCHES, LTD.** London, England



THE INSIDE STORY OF A MURRAY HIGH SPEED COMPRESSOR DRIVE TURBINE REVEALS THE REASONS FOR MURRAY'S UNIVERSAL ACCEPTANCE

A look at MURRAY'S rugged construction from the inside shows the husky shaft and heavy accurately formed discs with generous sized hubs designed to withstand the axial and radial stresses imposed by this type of service.

Large-dimension disc rims receive the specially contoured stainless steel blades with the Murray integral shroud. This insures smooth steam passages with maximum strength.

Short bearing spans insure smooth operation and eliminate the hazard of operating in critical speeds.

A look at the heavy flanges and husky bolting in the actual unretouched shop photo shown above bears out the extreme ruggedness that typifies every feature of Murray construction.

Our nearest representative will gladly help you solve your high speed compressor drive turbine requirements. Just write to Murray Iron Works Company, Burlington, Iowa for his name.

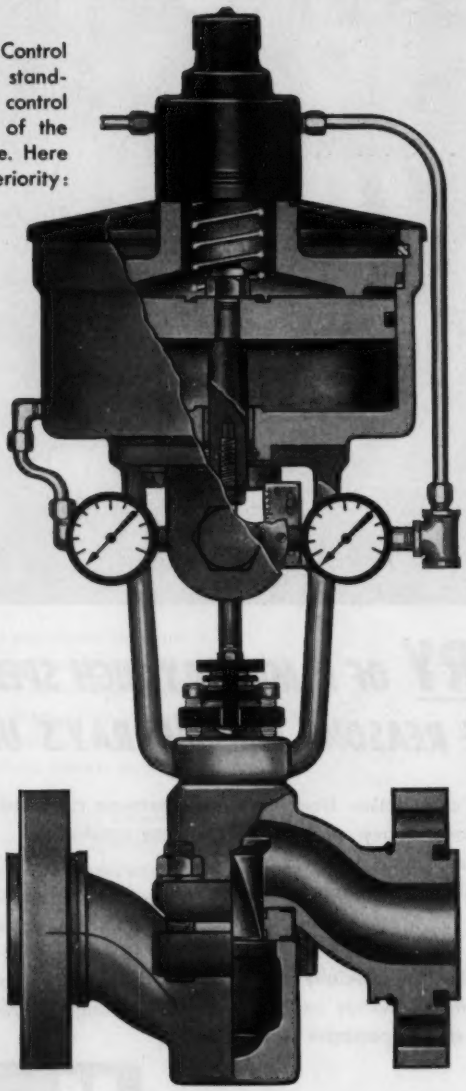
★ ★ **Murray Turbines** ★ ★

For more data on advertised products, use Readers' Service Cards, last page.

LOW FIRST COST
LOWER INSTALLATION COST
LOWEST MAINTENANCE COST

CONOFLOW *Series LB* CONTROL VALVES

Users say Conoflow Series LB Control Valves save more from every standpoint than any other type of control valve. This is based on years of the toughest applications experience. Here are the major points of superiority:



EASY TO INSTALL

Saves manhours. Compact, light yet strong.

INTEGRAL BONNET

Eliminates leakage at joints. Extra deep stuffing box for heavy duty packing. Oversized stem.

RENEWABLE SEAT RING

Quickly replaced with valve still in the line. No threaded insertions to corrode.

INTEGRAL POSITIONER

No exposed moving parts. Convenient zero adjustment while in operation.

PISTON POWERED

Sufficient power to operate under most adverse conditions. No diaphragm to fail.

SINGLE-SEATED DESIGN

Guaranteed tight shut-off over long periods of time despite heavy wear.

STREAMLINED PASSAGEWAY

No cavities for accumulation of deposits to interfere with operation.

CC707

WRITE FOR BULLETIN LB-2-A

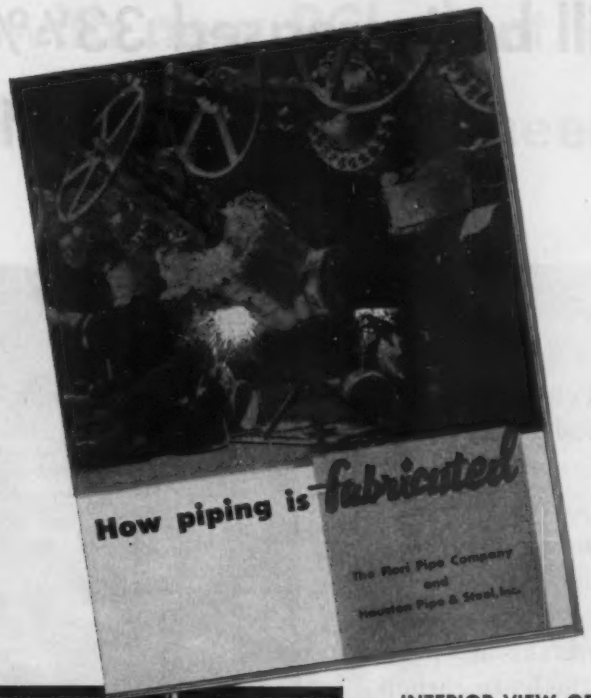
Cono-Controls®

CONOFLOW CORPORATION
2100 ARCH STREET, PHILADELPHIA 3, PA.

SUBSIDIARY OF WALWORTH

FOREMOST IN FINAL CONTROL ELEMENTS

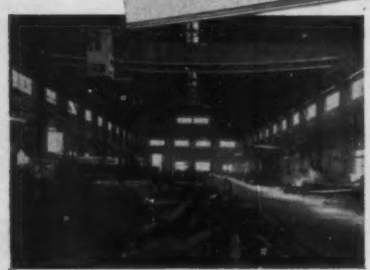
FREE brochure shows NEW PIPE FABRICATING TEAM



THE FLORI PIPE COMPANY and HOUSTON PIPE & STEEL, INC. JOIN FORCES

NEW TEAM ONE OF LARGEST PIPE FABRICATING OPERATIONS IN COUNTRY

Now operating under a single administrative and sales office in St. Louis, the new Flori-Houston team is geared to offer industry a new dimension in pipe fabrication production and service. The addition of the huge Houston Plant to the Flori facilities now offers unlimited production and the combined experience and know-how of all Flori-Houston personnel insures industry a continued high quality product.



INTERIOR VIEW OF HUGE HOUSTON PLANT

...unobstructed production facilities of 560 feet by 106 feet! Visual proof how the new Flori-Houston team can guarantee price . . . delivery . . . quality.

FREE BROCHURE
See the Flori-Houston team in operation.

WHAT THIS MEANS TO INDUSTRY...

1. **PRICE** . . . the new Flori-Houston team is production geared on a quality-volume basis to insure only the best piping at the lowest possible cost.
2. **DELIVERY** . . . the new Flori-Houston team with tremendous multi-plant facilities and service alert policies insures on-time delivery.
3. **QUALITY** . . . new Flori-Houston team combines years of technical experience in all phases of pipe fabricating which insures the same high standards of Flori quality familiar to industry since 1932.

MAIL COUPON TODAY FOR YOUR FREE COPY

GENERAL OFFICES

THE FLORI PIPE CO.

601 East Red Bud — St. Louis 15, Mo.

HOUSTON OFFICE

HOUSTON PIPE & STEEL, Inc.

P. O. Box 2, — Houston 1, Texas

Subsidiaries of Sparton Corporation

THE FLORI PIPE COMPANY
601 E. Red Bud, St. Louis 15, Mo.

Gentlemen, please rush free your new brochure "How Piping Is Fabricated," which gives complete information about the new Flori-Houston team.

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Company_____

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PR-57

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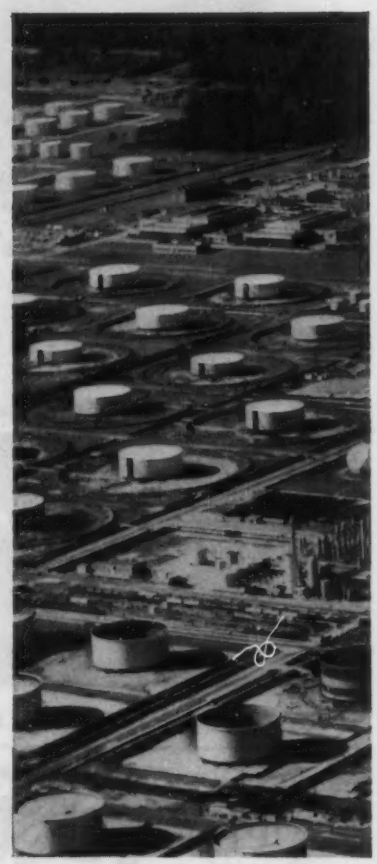
butyl

Nation's capacity will be increased 33⅓% to be built



Here at Lake Charles, Louisiana, Petroleum Chemicals, Inc. will expand its petrochemical facilities with the addition of a butyl rubber plant — to be built by Foster Wheeler.

With an initial capacity of 30,000 tons per year, this $17,000,000 plant will be the first one built since the war and its operation will increase the country's total butyl rubber capacity by about one third. This new plant will obtain its raw materials from the hydrocarbon streams available at the Lake Charles refineries of Cities Service and Continental Oil Companies, joint owners of Petroleum Chemicals, Inc.

Foster Wheeler is also building a 300 ton/day ammonia synthesis plant at the same site.

This is another example of how Foster Wheeler's design, engineering and construction experience is helping to meet the exact requirements of petroleum, chemical and petrochemical processing plants the world over.

Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

FOSTER WHEELER DESIGNS AND BUILDS

PETROLEUM, CHEMICAL AND PETROCHEMICAL PROCESSING PLANTS

ANYWHERE IN THE WORLD!

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rubber

with new PCI plant here by Foster Wheeler

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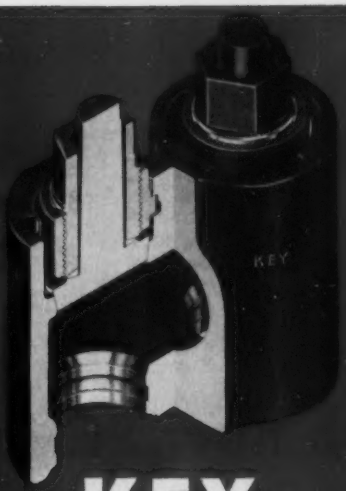

KEY 5000 TYPE RETURN BEND FITTINGS

SERVE FURNACES AT THE TEXAS COMPANY'S EAGLE POINT WORKS

These unique fittings provide substantial economies, because their simple construction and high degree of interchangeability permit considerably less inventory than conventional fittings of their type.

With two series available of nine fittings each, the 18 fittings contain only 26 parts instead of the conventional 72.

Let us show you how new Key 5000 Type Fittings can serve you more efficiently and economically. Write today for complete information.

- **simpler construction**
- **higher interchangeability**
- **lower inventories**

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DIVISION OF acf INDUSTRIES INCORPORATED
Plant: Missouri City, Texas • Mailing Address: P.O. Box 2117, Houston, Texas

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KEY RETURN BENDS AND FITTINGS

W-K-M THROUGH-CONDUIT GATE VALVES

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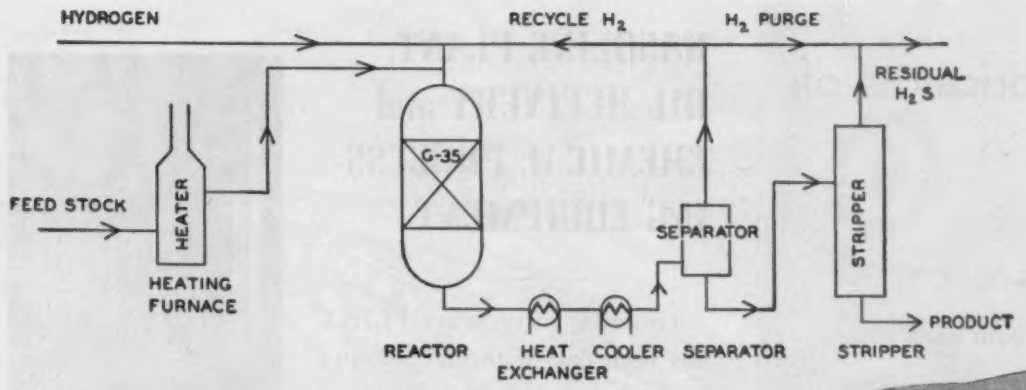

Naphthas, middle distillates, gas oils and lube stocks can all be upgraded by hydrogen treating with the use of new Girdler G-35 catalysts. These highly active cobalt molybdenum catalysts were developed specifically for the desulfurization, denitrification and stabilization of petroleum feedstocks covering a wide molecular weight range. Typical flow diagram is shown.

Check these outstanding benefits of G-35 hydrogen-treating catalysts

G-35 HAS OUTSTANDING PHYSICAL PROPERTIES — these are retained even after extended use. Permit outstanding operational flexibility, continuous economical operation with essentially 100% yields.

IMPROVEMENT OF COLOR stability, lead susceptibility, burning characteristics and the removal of poisons from catalytic reforming feedstocks are among the more important results achieved. Girdler's expanded production facilities are geared to meet your needs for G-35 catalysts.

DETAILED INFORMATION is available on G-35 catalysts. Bulletin GC 304 discusses applications, gives process conditions for various distillate stocks, performance features and typical catalyst specifications. Free on request.

CATALYST DEPARTMENT

the GIRDLER Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

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GIRDLER MANUFACTURES CATALYSTS FOR: HYDROGENATION • SYNTHESIS GASES AND HYDROGEN GENERATION • DESULFURIZATION • NEW CATALYTIC PROCESSES

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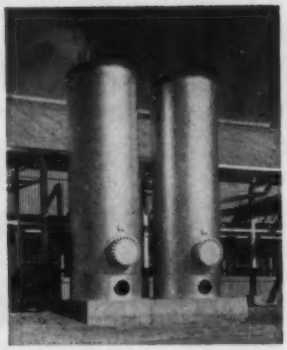
GASOLINE PLANT, OIL REFINERY and CHEMICAL PROCESSING EQUIPMENT

For over forty years FLINT **has been** one of the largest and best equipped fabricators of **Process Equipment** for the Oil & Chemical Industries.



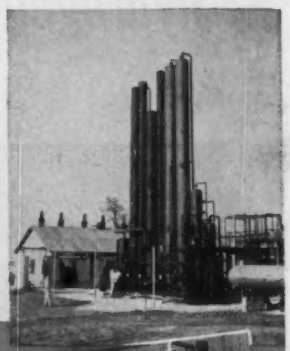
Roll capacity is 1¾″ or 2″ thick plate. Flint also has Radiograph and stress relieving equipment.

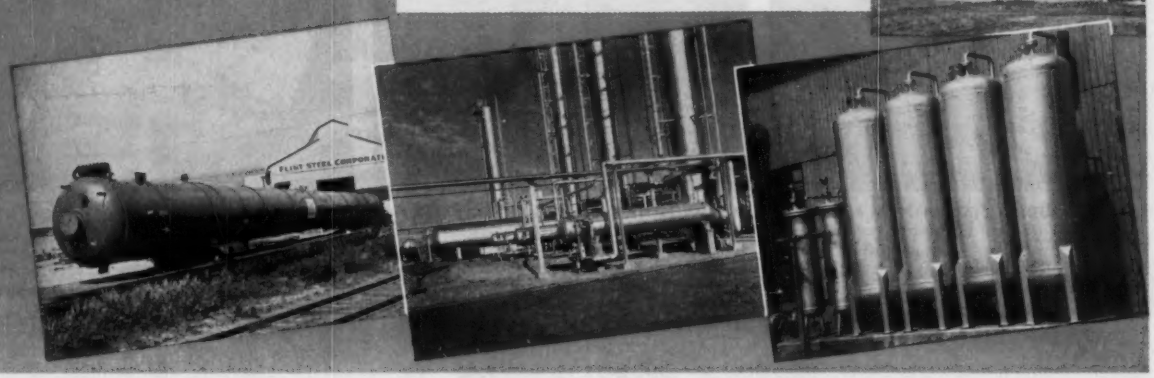
API-ASME or the ASME CODE for Unfired Pressure Vessels is complied with readily.

Stress relieving furnace is 15′ 2″ wide by 85′ long.

Prompt, personal handling of your inquiries is assured.

Write for a brochure covering TULSA TYPE Petroleum Processing Equipment.





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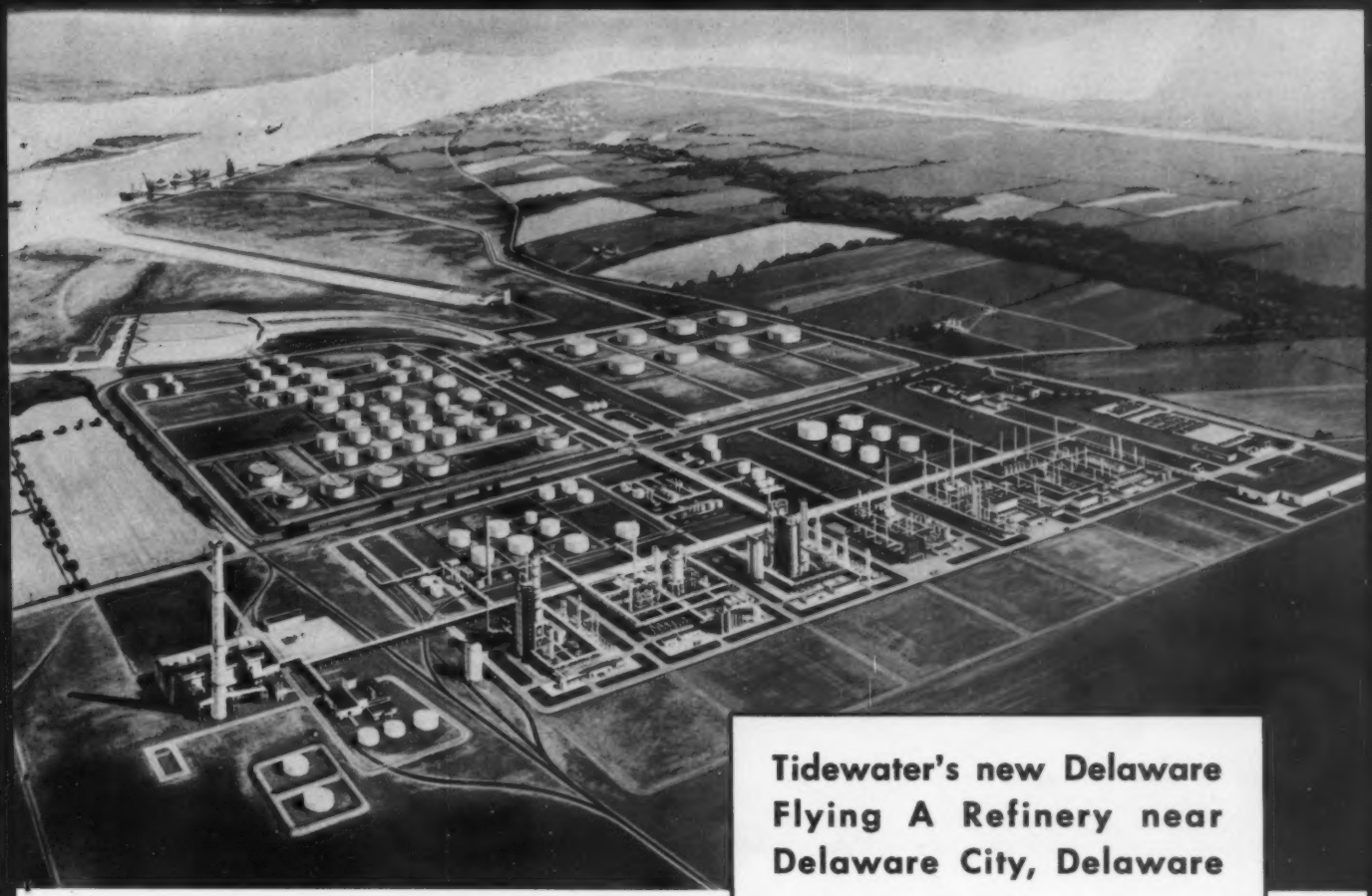
TULSA ..... MEMPHIS



Tidewater's new Delaware Flying A Refinery near Delaware City, Delaware

Electricity... instead of steam...

powers most of refinery processing equipment

Unique electrical distribution system provides outstanding power continuity

Tidewater Oil Company's new 130,000-barrel-per-day Delaware Flying A Refinery in Delaware, designed and constructed by C. F. Braun & Co., is of special interest because of the high degree of dependence placed on the electrical distribution system. This is especially significant since it is the world's most modern refinery, with the largest initial capacity of any refinery yet built.

With continuity of power a "must"—for even a power failure of a few seconds cannot be tolerated—the problem was to work out systems and components which would set a new high in continuity of operation.

In doing this, certain motors were modified for 250% breakdown torque at normal voltage to meet the special requirements for reacceleration after a fault. It was then necessary to design the control with low drop-out characteristics.

This meant the closest type of relationship was required between all the Allis-Chalmers engineering departments concerned, and C. F. Braun & Co., prime contractors for the tremendous project.

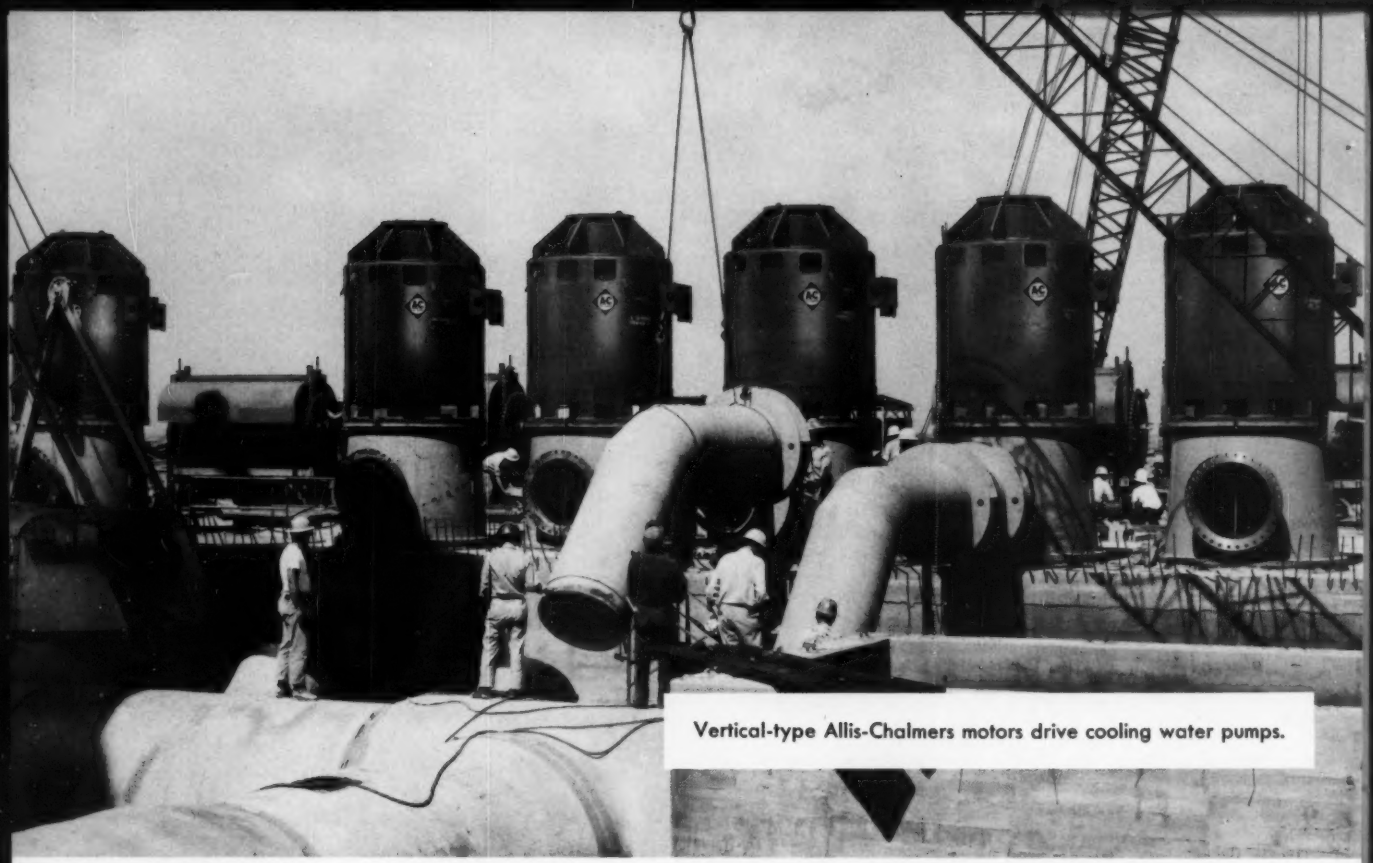
As on other complex jobs, group effort was used to provide coordination between departments, and to take advantage of the variety of experience in each department. Conference phone calls were used to handle matters of delivery and design modifications that came up during construction. In this way, problems could be considered quickly and decisions made immediately.

A network analyzer was used extensively to study the effect on the system of the worst possible faults, thus saving months and months of calculations.

Experience and coordination like this is available to you on applications involving Allis-Chalmers broad line of electrical equipment. Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

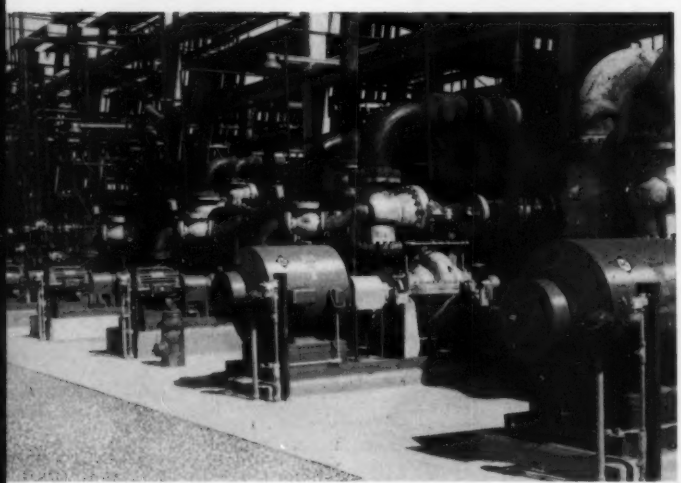
ALLIS-CHALMERS

A-5247

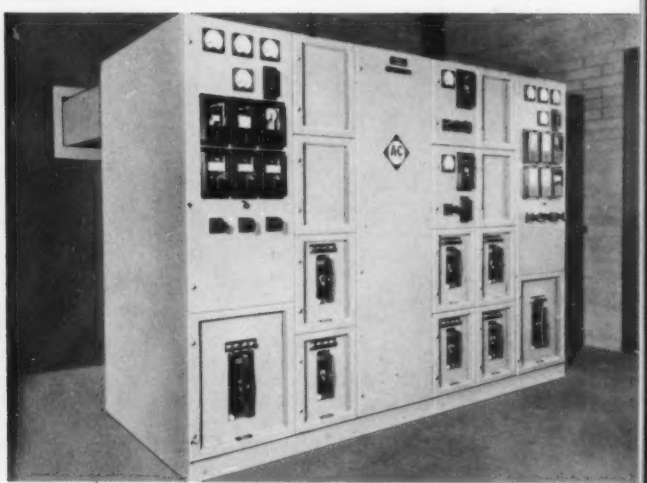


Vertical-type Allis-Chalmers motors drive cooling water pumps.

Electricity at work throughout

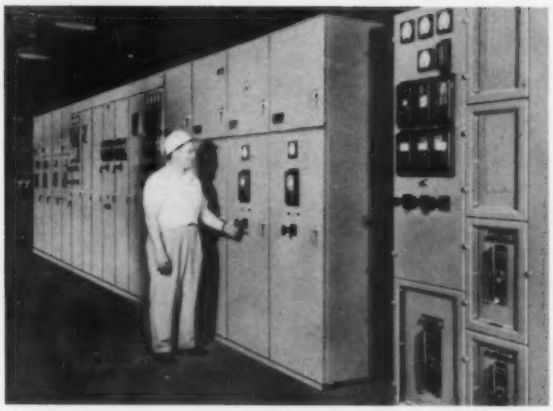


A few of the 300 Allis-Chalmers motors used for driving pumps, compressors and other equipment. Motors in foreground feature tube-type, air-to-air heat exchanger.



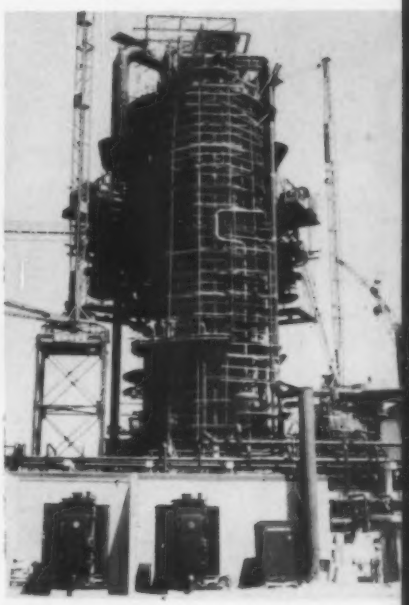
Allis-Chalmers new low voltage switchgear incorporates selective trip, an absolute requirement on the job, in addition to its many other features.

ALLIS-CHALMERS



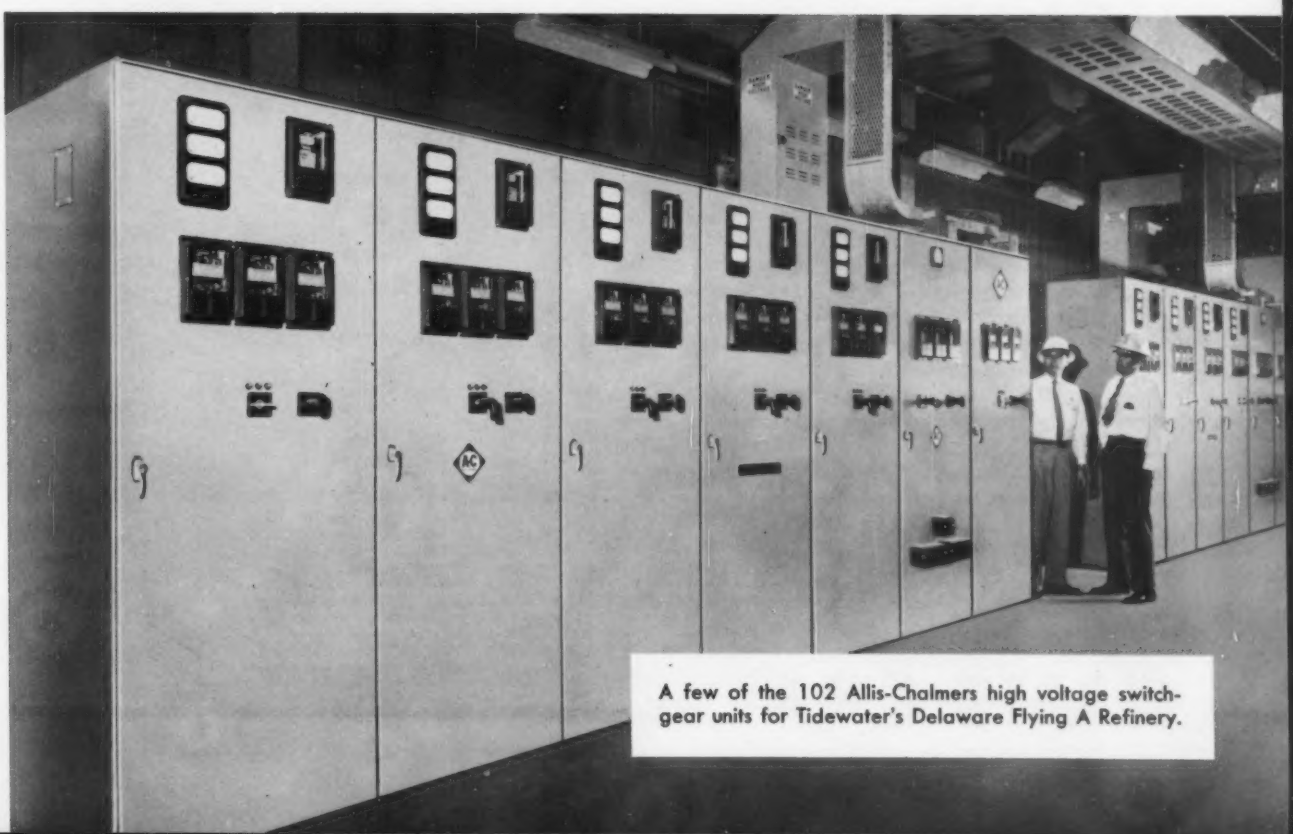
All the motor control and switchgear are located inside switch houses. These buildings are pressurized to exclude explosion vapors. Bus duct systems are pressurized.

Teamwork! A part of the Allis-Chalmers coordinating team is shown during one of frequent meetings.



All transformers are oil-insulated, sealed-tank construction with welded-on tubular radiators. They are equipped with high voltage disconnecting switches, capable of breaking magnetizing current. Fan motors are explosion-proof.

Tidewater's New Refinery



A few of the 102 Allis-Chalmers high voltage switchgear units for Tidewater's Delaware Flying A Refinery.

More than 125 high voltage motor controllers are used at the new Delaware Flying A Refinery.

Motor Control is one of the Key Factors in assuring Power Continuity

To permit motors to remain on the line through severe system voltage disturbances, important design developments were made in both the 2300-volt motor control circuits and main motor starting contactors.

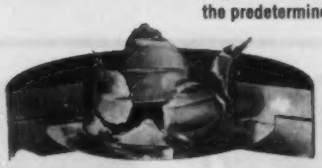
The magnetic circuit of the high voltage air contactor was redesigned so that it would remain closed, even though magnetically held, for a period of 19 cycles after complete loss of power. In addition, the magnetic circuit remains sealed even when the voltage drops to 35% of normal.

Get details! These developments are important wherever continuity of operation is vital. Allis-Chalmers engineers can help you. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Two separate studies were made using a network analyzer. Teams from Allis-Chalmers and C. F. Braun & Co. worked together to assure power continuity.

ALLIS-CHALMERS

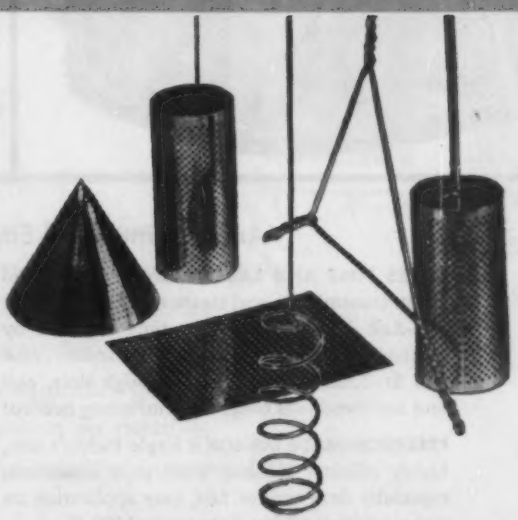
RUPTURE DISCS... discs of precious metals, resistant to most corrosive agents and unattacked under conditions that base metals could not withstand. Specific physical properties ensure bursting only at the predetermined pressure.



DEOXO® PURIFIER... provides low-cost catalytic purification of hydrogen and other gases to the extent of less than one part oxygen per million. Requires no operating expense, no maintenance, no reactivation, no auxiliary heating, no water cooler. Extremely simple installation.

important for petroleum processing...

SUPER-SENSITIVE DEOXO® INDICATOR... for measuring oxygen or hydrogen present as impurities in other gases. Accurately indicates from 0.0002% to 0.0200% (2 to 200 parts per million) oxygen, and from 0.0004% to 0.0400% hydrogen. A dual range permits measurement of up to 0.25% oxygen or 0.5% hydrogen.



LABORATORY WARE... a wide variety of forms and sizes for chemical and physical purposes, made of platinum or any desired alloy. Line includes crucibles, reshapers, triangles, dishes, electrodes, anodes and cathodes.

Write for complete catalog material and details

BAKER PRECIOUS METALS

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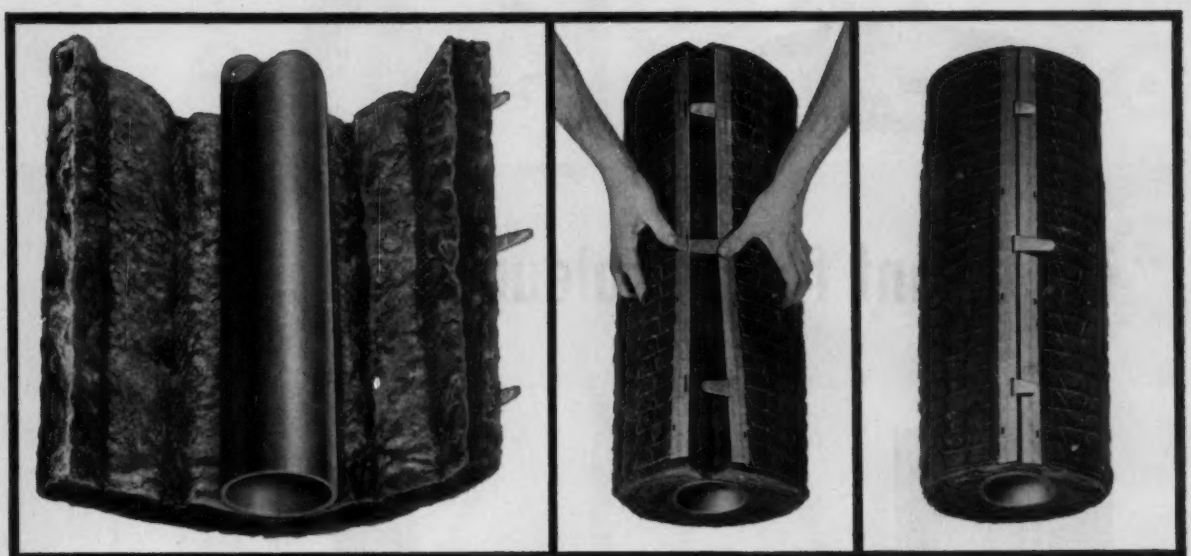
ENGELHARD INDUSTRIES

NOW! HIGH TEMPERATURE INSULATION - EASY TO APPLY

EAGLE-PICHER
TAB-LOK
PIPE INSULATION
For temperatures up to 1200F



And it's made of Eagle-Picher Mineral Wool!

SAVES TIME AND LABOR! On long overhead steam transmission and steam tracer lines, apply *Tab-Lok* in about half the time required by ordinary pipe coverings. Easy to handle... cut and fit... simply draw tabs through slots, pull taut and bend tabs over. No reinforcing needed!

PRECISION-MADE TAB-LOK is Eagle-Picher's new, highly efficient mineral wool pipe insulation, especially designed for fast, easy application on steam piping and hot lines up to 1200 F.

TIGHT, UNIFORM INSULATION! Durable metal fabric and galvanized strips keep *Tab-Lok* in uniform alignment. The unique tab-and-slot feature assures tight, close-butted joints.

WHAT'S MORE . . . Eagle-Picher's new *Tab-Lok* pipe insulation is highly resilient for minimum stress in expansion and contraction of heated equipment. It's water-repellent, corrosion-resistant, fire-resistant, vibration-resistant! Its greater efficiency plus ease and speed of application, saves you money!

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

Since 1843

EAGLE EP PICHER

EAGLE-PICHER

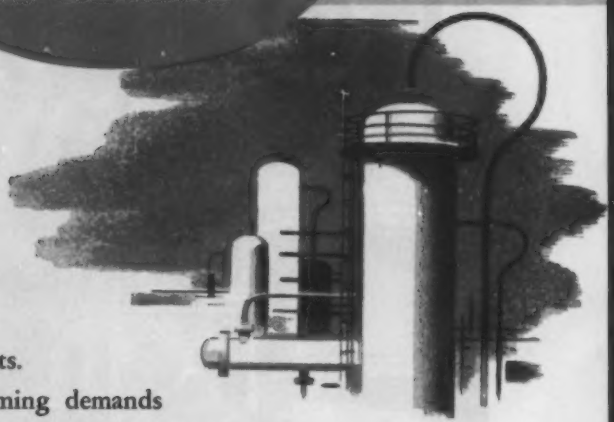
The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

(*Member of Industrial Mineral Fiber Institute*)

Accuracy...

is TRADITIONAL at WESTERN

Accuracy
IS VITAL TO
CATALYTIC
REFORMING



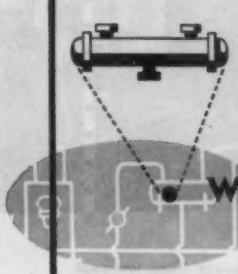
Many of our customers employ a catalytic reforming process in the production of premium motor fuels, high yields of aromatic hydrocarbons, or high-quality aviation gasoline components.

Whatever its application, catalytic reforming demands *unerring accuracy* in the heat transfer equipment employed—accuracy in rating—in design—in welding—in complete fabrication.

Western Heat Exchangers meet these demands because Western's rating and design engineering—manufacturing techniques—close attention to detail—are dedicated to *accuracy first.*

Western has successfully participated in the development of many catalytic reforming units now in service throughout the world.

Western's representatives stand ready to serve you . .



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WESTERN SUPPLY COMPANY
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Out of our working partnership with refiners

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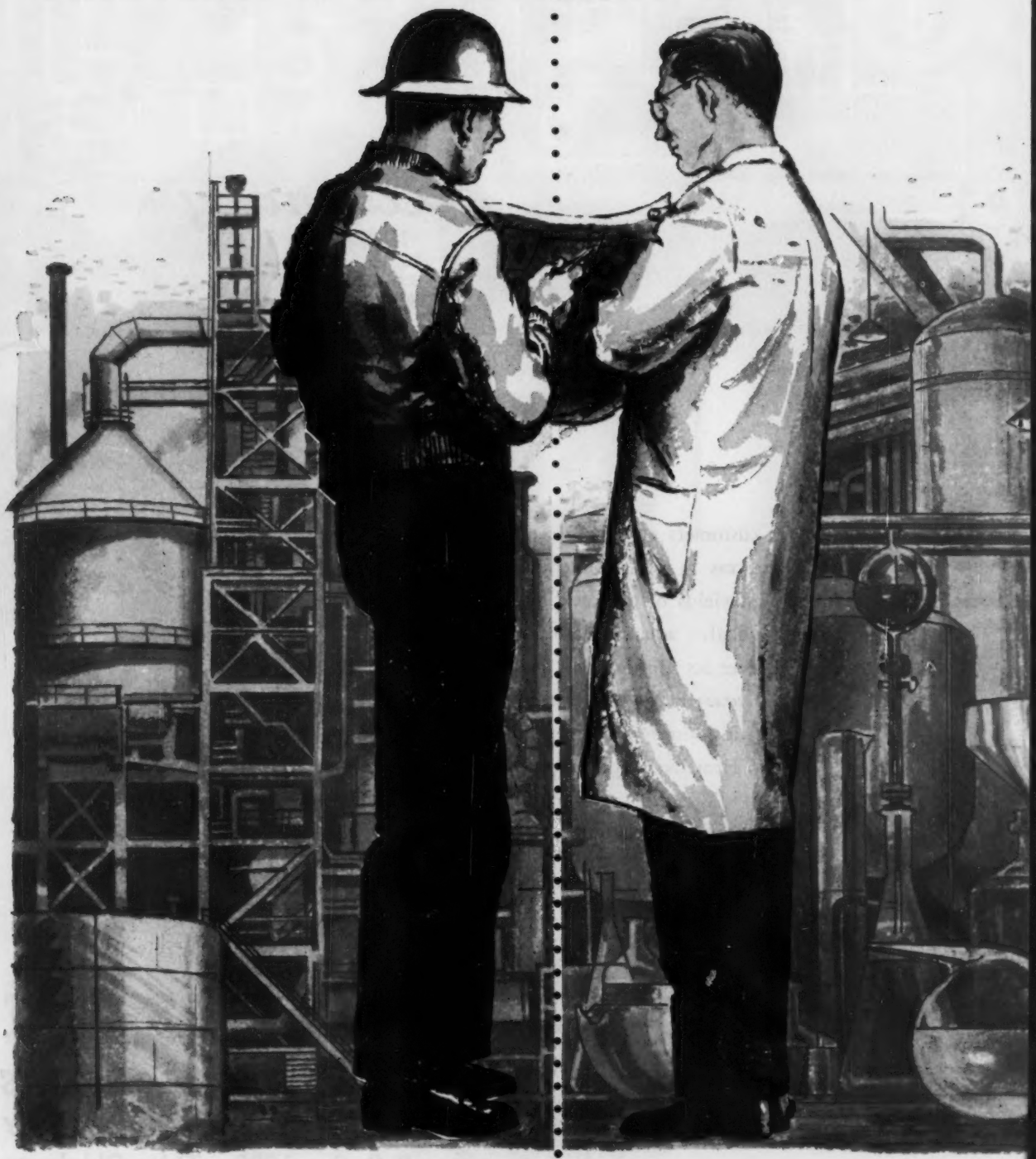

PERFORMANCE CATALYSTS

prove again and again it's results that count!

OPERATING REFINERS AID CYANAMID IN DESIGNING SUPERIOR CATALYSTS

Now you can get the highest efficiency yet in fluid catalytic cracking! Cyanamid has enlarged and improved its manufacturing facilities for regular and high-alumina AEROCAT Catalysts as a result of technical advances in catalyst manufacture developed at its Stamford, Connecticut Research Center.

Refiners have long recognized that no one factor dominates in catalyst performance. Cyanamid's consistent objective has been to bring every variable in catalyst properties into balance for peak performance under varying refinery operating conditions. Our development work has always been based on operating and research data provided directly by refiners . . . a cooperation which has paid large dividends in cracking efficiency.

New equipment developed by Stamford Research contributes to a unique manufacturing process, governed at every production stage by rigid laboratory-checked controls. This enables us to maintain commercial production at research quality standards.

Your evaluation of the new AEROCAT Catalysts is invited. Our technical service and research staffs will do their best to help you get on stream to greater productivity.

Unique vapor phase chromatography apparatus developed by our Stamford Research Center automatically identifies volatile organic liquids. Apparatus permits rapid evaluation of catalyst efficiency at the refinery or under laboratory conditions. It is typical of the highly specialized equipment used at Stamford for catalyst research.

Again, it's *results* that count—and the relative importance of *all* catalyst properties has been under exhaustive research in laboratories of Cyanamid and its customers. In this way, AEROCAT Catalysts have been improved to give refiners highest cracking efficiency.

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REFINERY CHEMICALS DEPARTMENT
30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

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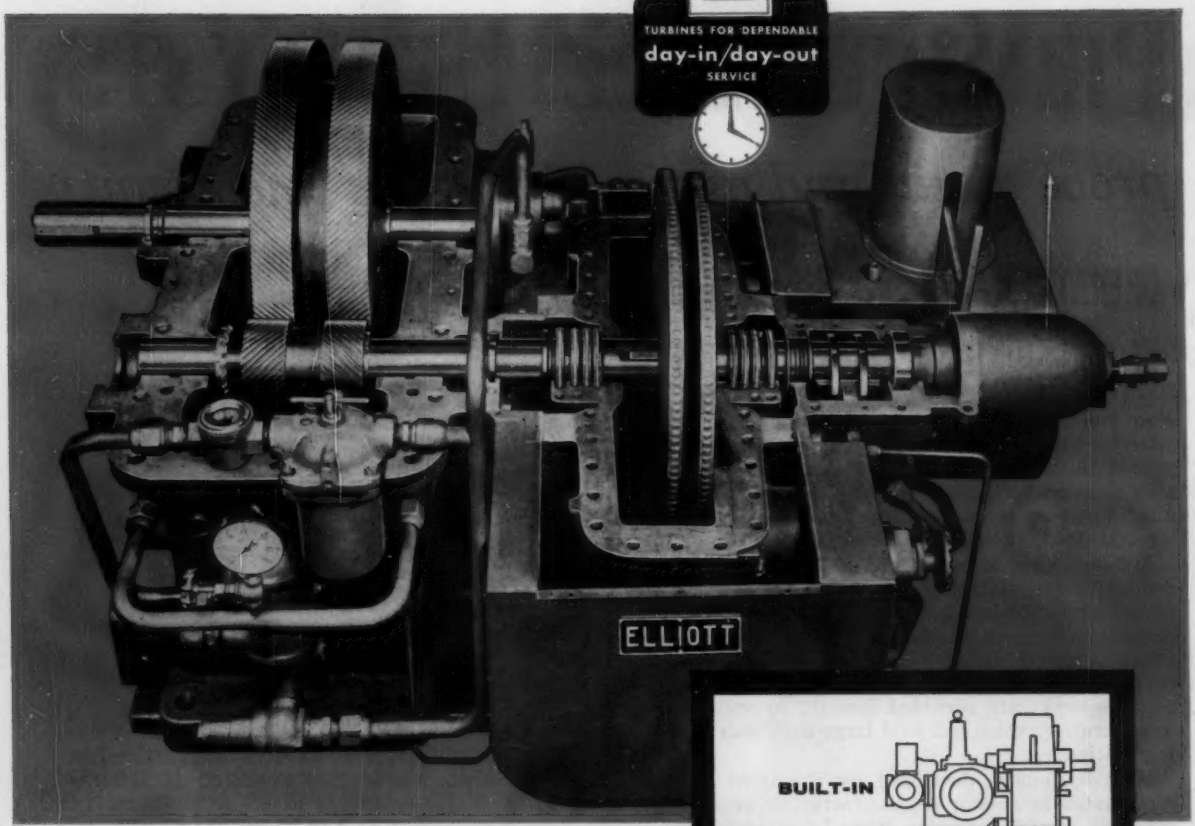
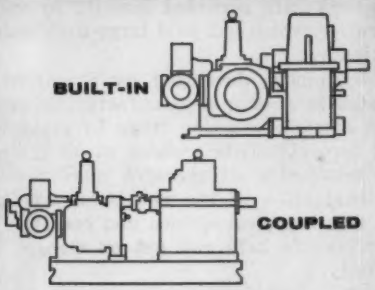


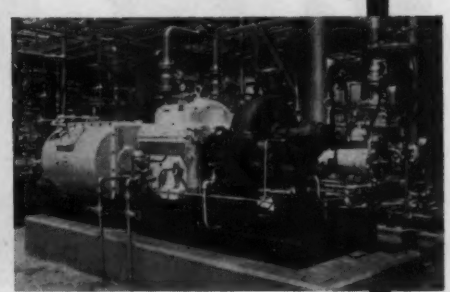
ELLIOTT *Geared* TURBINES

extend Elliott Turbine efficiency to broader range of applications

In operating many low-speed machines—such as fans, pumps, compressors and lineshafts—maximum overall efficiency is achieved by employing high-speed steam turbines which drive the machines through reduction gearing. Elliott has long been a leader in the design and application of geared turbines, built-in or coupled, which drive lower-speed machines without sacrificing the compact size or high operating efficiency of the turbine.

Design features of the built-in type, seen in the cutaway above, include: compact, rugged turbine and gear case, one-piece high-speed shaft, double-helical gear and pinion, dynamically balanced gears, liner-type bearings. These and other advantages assure sustained operating efficiency over the years. For details, ask your local Elliott field engineer for Bulletin H-19, or write Elliott Company, Steam Turbine Department, Jeannette, Pa.





Here a compressor in a petro-chemical plant is driven through separate Elliott reduction gearing by a YR turbine. In this type, the gears are coupled to the turbine by flexible couplings.

M7-3

ELLIOTT Company

Steam Turbines • Motors • Generators • Deaerating Heaters • Ejectors • Condensers • Centrifugal Compressors • Turbochargers • Tube Cleaners • Strainers

now on stream...

1st Large Virgin Gas Oil Refining Unit using QO® Furfural

Large Virgin Gas Oil Refining Unit of The Texas Company at Los Angeles, California. Capacity, 25,000 Barrels per day.

Furfural is used to prepare stocks for catalytic cracking because it:

- Removes carbon-forming material
- Extracts heavy metal contaminants
- Decreases sulfur content
- Reduces aromatic content
- Produces high yield of raffinate to be charged to fluid catalytic cracking unit

Results are:

- Improved quality and yield of gasoline
- Lowered operating cost of gasoline production due to increased catalyst life

Not to be overlooked is the fact that when necessary, furfural can refine in one unit, lube oil, cycle stock or virgin gas oil as demand dictates. In all three operations QO furfural offers excellent selectivity, ease of recovery, low cost, ready availability, and freedom from excessive toxicity. The process to refine hydrocarbon oils with furfural is licensed by Texaco Development Corporation, 135 East 42nd Street, New York 17, New York.

Write for our Bulletin 203-A
"Physical Data on Furfural"

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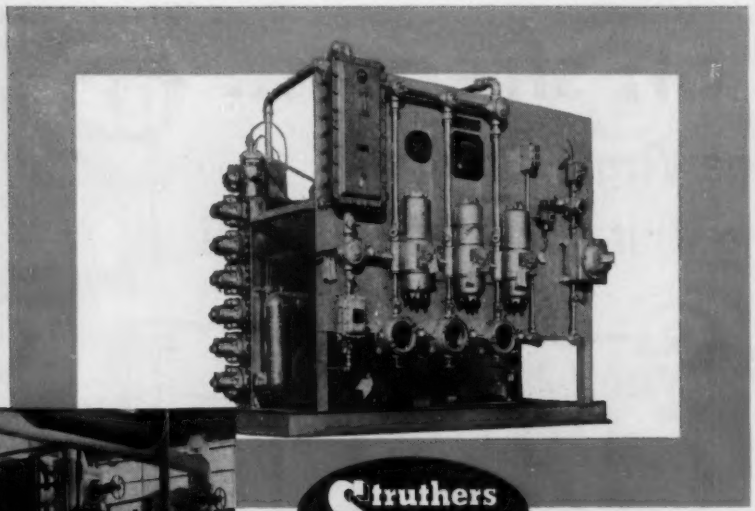
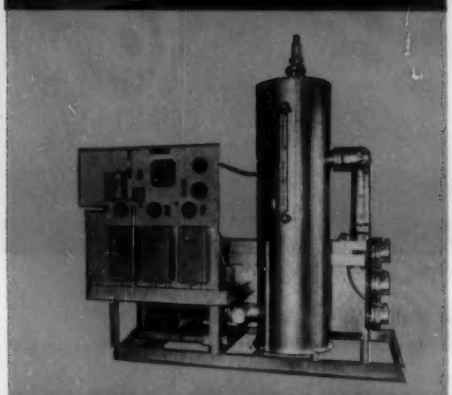
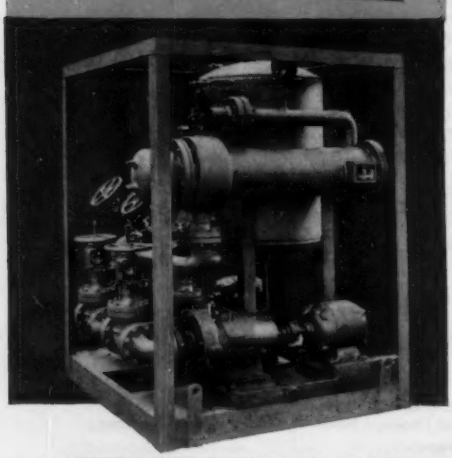
F. Kanematsu & Company, Ltd., Tokyo

For more data on advertised products, use Readers' Service Cards, last page.







Struthers Wells

High Temperature Heating

by Circulating Medium

Struthers Wells supplies circulating heating equipment for a wide range of temperatures and sizes. Many smaller units can be supplied as a "package," completely assembled and ready for operation.

The units illustrated show three electrically heated units for Dowtherm and other fluids, for capacity to above 1,000,000 BTU per hour. Also shown is a circulating cooling unit, (lower left side illustration).

Struthers Wells can supply standard units for capacities from 100,000 BTU per hour to about 40,000,000 BTU per hour. Temperatures range from about 350°F to above 1500°F.

Fired heaters for a wide range of services, including steam superheating, oil and gas heating are also a Struthers Wells specialty. Hundreds of units are in successful service.

If you require heat above the temperature range of available steam pressures, Struthers Wells engineering experience and facilities are always available.

Struthers Wells

STRUTHERS WELLS *Corporation*

WARREN, PA.

Plants at Warren, Pa. and Titusville, Pa.

Offices in Principal Cities

Struthers Wells Products

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

BOILER DIVISION

BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION

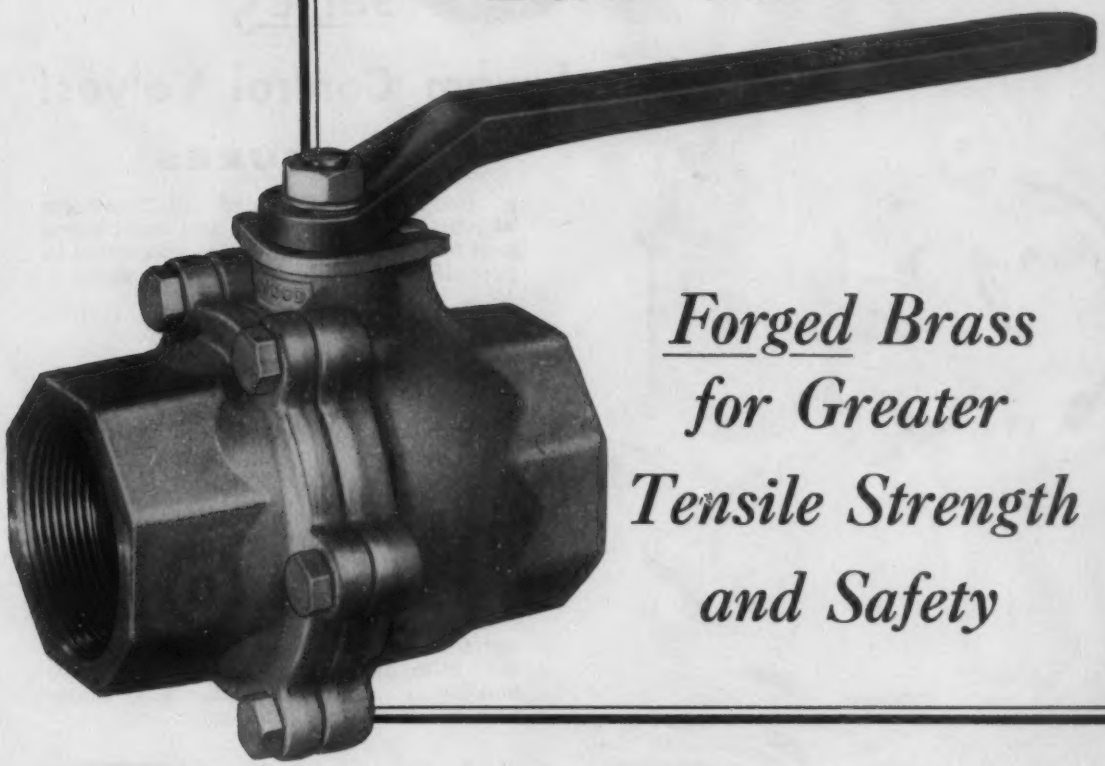
Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

MACHINERY DIVISION

MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

For more data on advertised products, use Readers' Service Cards, last page.

NEW Rockwood Ball Valves



Forged Brass for Greater Tensile Strength and Safety

Here's another Advantage — Full, Round Flow!

The new Rockwood Forged Brass Ball Valve assures you of Full, Round Flow — you get fast, efficient operation (¼ turn opens or closes valve) and less friction loss. The handle can be attached in any of 8 different positions for greatest convenience.

And another Advantage — Leakproof!

In closed position the pressure of fluid in the Rockwood Forged Ball Valve *automatically* positions ball against the synthetic rubber seat to form a tight, leakproof seal. There are several seat materials available for different applications.

And still another Big Advantage — Longer Wear!

The brass ball in the Rockwood Forged Valve is chrome-plated to stand up under abrasion, pitting, scratching.

Rockwood's new Forged Brass Ball Valve gives you trouble-free service. That means longer time between replacements . . . less maintenance on the job — more for your money in every way.

You can get this new valve in all pipe sizes. Tested and listed by Underwriters' Laboratories, Inc. Mail the coupon now for complete information.

ROCKWOOD BALL VALVES

FULL, ROUND FLOW

ROCKWOOD

ROCKWOOD SPRINKLER COMPANY
1291 Harlow Street
Worcester 5, Mass.

Send me illustrated folder on Rockwood Full, Round Flow Ball Valves.

Name.....

Title.....

Company.....

Street.....

City.....*Zone*..*State*.....

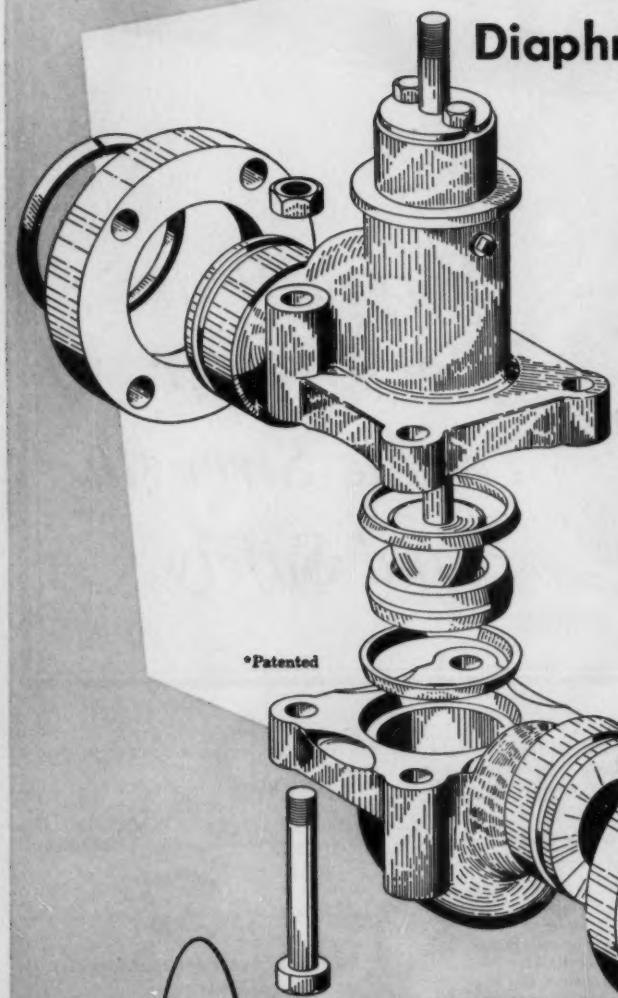
For more data on advertised products, use Readers' Service Cards, last page.

For Complex Fluid Control Problems . . .

Specify The New SPLIT BODY

Super 70 series

Diaphragm Control Valves!



*Patented

FEATURES

✓ Body halves are joined with four bolts at junction of valve body and inner valve seat for easy access. May be assembled to provide either globe or side angle flow.

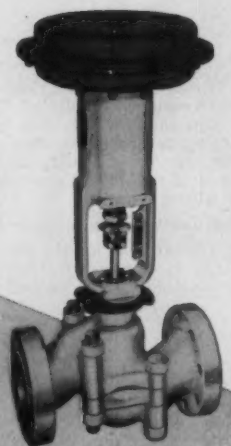
✓ Seats are available in metal, Nylon, Teflon or Kel-F.

✓ Tight closures without resort to gaskets are insured by BS&B Float Ring Seals.*

✓ Actuator may be quickly oriented to any convenient position by means of clamp ring mounting.

✓ Fewer parts mean simplified maintenance when handling erosive, corrosive or viscous liquids.

✓ Standard body materials are cast steel or 316 stainless in 1" to 3" sizes with a selection of inner valve types. 600 lb. ASA body with interchangeable line flanges—150, 300 and 600 lb. raised face. Other body materials available on special order.



EFFICIENCY OVER 60 YEARS BS&B RELIABILITY ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

For Complete Information, Ask Your BS&B Sales Engineer—or Write for Catalog 70-11.

BLACK, SIVALLS & BRYSON, INC.

Controls Division, Dept. 4-F4

7500 East 12th Street Kansas City 26, Missouri

5086

HIGHEST STRENGTH ALUMINUM FOR UNFIRED PRESSURE VESSEL FABRICATION

Kaiser Aluminum now offers you alloy 5086 . . . the highest strength aluminum alloy available for the fabrication of unfired pressure vessels.

Non-heat-treatable 5086 is designed specifically for welded structures requiring maximum joint strength and efficiency, plus light weight and corrosion resistance.

And, with high-strength 5086 you can take advantage of inert-gas, shielded-arc welding methods for faster welds and pressure tight joints.

Development of 5086 by Kaiser Aluminum makes possible many new applications of light weight, durable aluminum for the chemical and petroleum industries. Find out now how this versatile alloy can serve you.

For complete information, call the Kaiser Aluminum sales office listed in your phone directory. Process Industries Department, Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois; *Executive Office*, Kaiser Bldg., Oakland 12, California.

PHYSICAL CHARACTERISTICS OF ALLOY 5086

Typical mechanical properties in various tempers

	Temper			
	"0"	H32	H34	H112
Tensile strength (psi)	38,000	42,000	47,000	39,000
Yield strength (psi)	17,000	30,000	37,000	19,000
Elongation (% in 2")	22	12	10	14

Allowable design stress values

	For metal temperature not exceeding deg. F.	
Condition (temper)	100°	150°
Annealed	8700 psi	8700 psi
H112	8700	8700
H32	10,000	9900
H34	11,000	10,800

Allowable stress values for welded construction compared with other alloys

Alloy Designation		For metal temperature not exceeding 150° F. (annealed condition)
AA	ASTM	
1160	996A	1650 psi
1100	990A	2350
3003	M1A	3150
3004	MG11A	5650
5050	G1A	4000
5052	GR20A	6250
5154	GR40A	7350
5086	GM40A	8700

Nominal composition

4.0% magnesium
0.45% manganese
0.10% chromium

Typical weld strengths (specimens tested across the weld)

37,000 psi tensile strength
18,000 psi yield strength
13% elongation

Kaiser aluminum 5086 is available in flat and coiled sheet, plate and extrusions.

Kaiser Aluminum

materials for the process industries

See "THE KAISER ALUMINUM HOUR." Alternate Tuesdays, NBC Network. Consult your local TV listing.

For more data on advertised products, use Readers' Service Cards, last page.

THE FULLEST MEASURE OF SERVICE

Our company has often been called the leading independent petroleum research organization. This may be true, as far as it goes, but it falls far short of a true description of our function in the great petroleum industry. In the broad sense, UOP is a *service* organization operating on the basic objective of improving petroleum refining technology in order to help any refiner better his operating and economic position by producing a larger volume of higher quality petroleum products from each barrel of oil he processes. The attainment of this objective encompasses a wide field of endeavor.

It all starts in our laboratories. Here, in an ideal research atmosphere, scientists and technicians search out that elusive new idea that will provide a better and more efficient refining process or method.

We may follow many unfruitful paths and carry out diverse experiments until we find a promising approach. Then it is analyzed and evaluated by UOP's top-flight group of scientists and engineers. This expert consideration determines the practical importance of the theory. This application is then carefully developed in exhaustive pilot plant investigations. Standard facilities are maintained for this or special ones developed as necessary. These pilot plant studies also give helpful design data and cost information on plant construction and product manufacture.

When proved, the new process becomes available for license by any refiner, anywhere.

We realize fully our responsibility to provide the licensee with the pattern to make UOP processes work in practical commercial operation. Our process engineers, our designers and other technical specialists render a complete detailed design of the commercial process unit.

Having designed the equipment to make the process work, we do all we can to make sure that the plant built for the process will perform efficiently. So we make available to our licensees experienced UOP engineers to supervise its construction.

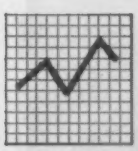
Regardless of the quality of the design and construction, it still takes people to run a refinery.

TO THE OIL REFINING INDUSTRY

That's why we provide a comprehensive instruction program for licensee plant operational personnel. This insures the know-how to make facilities and process work together properly.

We never forget our customers. To help the refiner maintain his plant at the top level of safety, efficiency and profitability we offer the on-the-spot assistance of our experienced engineers and inspectors.

Beyond this basic development and servicing of UOP processes we provide a variety of laboratory services to our licensees and customers in the petroleum refining industry. These include evaluation of crudes, product examinations, analyzation of automotive, jet and diesel fuels and other materials important in the day-to-day operation of a refinery.



Beyond its development, design and service functions, Universal appreciates the problems inherent in the constantly changing economics of manufacturing and marketing. Therefore it offers the services of its experienced Market Research and Economics Group.

Through forty years, the world around, Universal has been responsible for the development of many of the most important refining processes now in use. Even more important, we believe, is the broad and thorough measure of service we have consistently provided the users of our processes to assist them in making products from petroleum economical to manufacture and profitable to market at prices within easy reach of every man's purse.

Forty Years Of Leadership In Petroleum Refining Technology

UNIVERSAL OIL PRODUCTS COMPANY

30 Algonquin Road
Des Plaines, Illinois, U. S. A.

Step up safety, performance and service life with Vogt

Rugged Vogt Drop Forged Steel Gauge Cocks on this Natural Gasoline Storage Tank at Warren Petroleum Corporation's San Pedro California Terminal, are unsurpassed for safety to contents and to plant personnel. If a gauge cock glass should be accidentally broken, balls in the gauge cocks would automatically shut off the liquid until repairs were made.

Reliable, trouble-free, outdoor operation year after year in exacting services of this kind is yours when you install Vogt Drop Forged Steel Liquid Level Gauges.

HENRY VOGT MACHINE CO., P. O. BOX 1918, LOUISVILLE 1, KY.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati.

Drop forged steel, Automatic Liquid Level Gauges

SECTION THRU GAUGE COCK

See Catalog F-9 for complete data on gauge cocks, trims, and gauge glasses for specific operating conditions or write Dept. 24A-FPR.

OTHER VOGT PRODUCTS

Drop Forged Steel Valves, Fittings, and Flanges • Petroleum Refinery and Chemical Plant Equipment • Steam Generators • Heat Exchangers • Ice Making and Refrigerating Equipment.

KONTOL

...a proved gasoline plant corrosion preventive

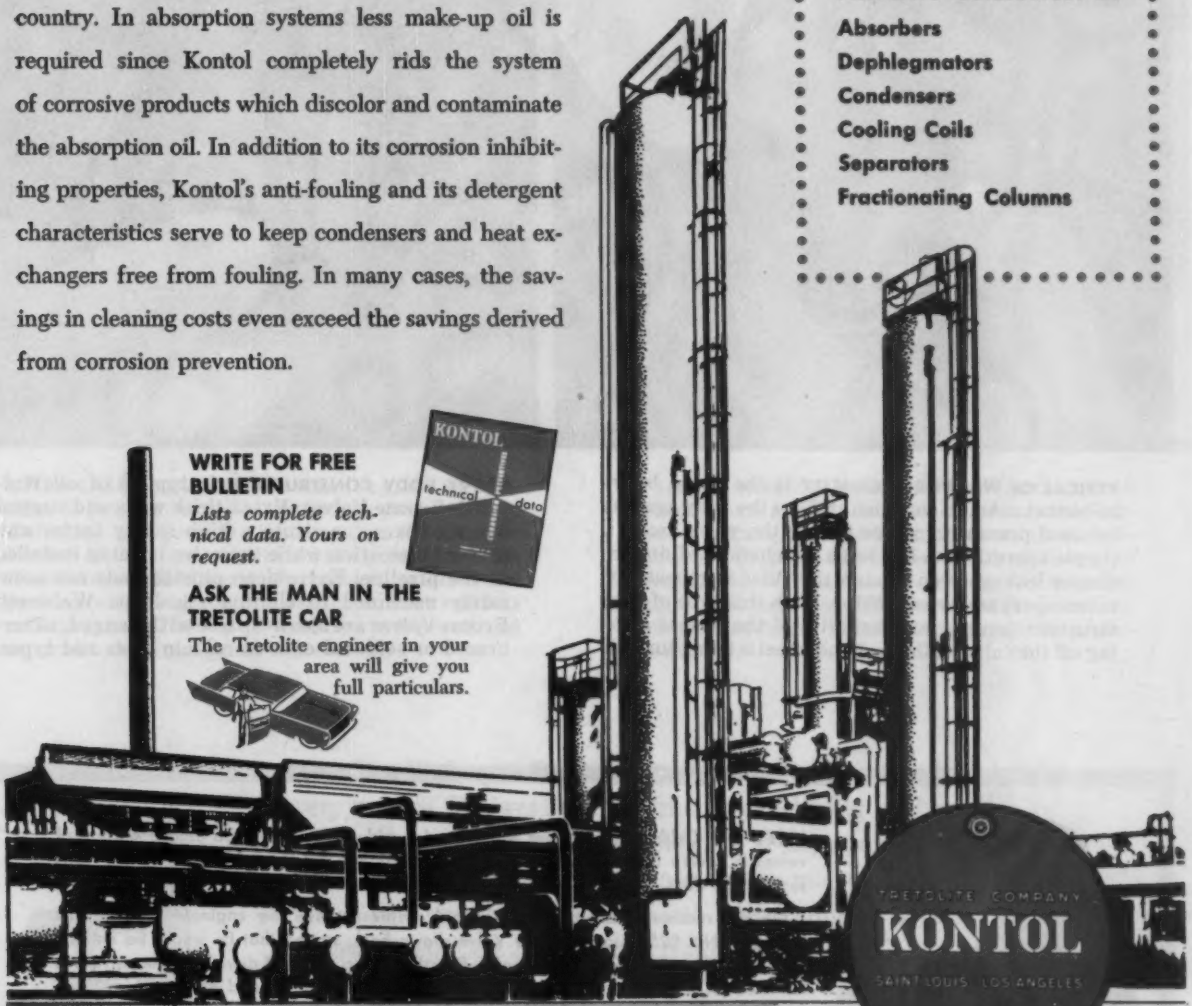
In the gasoline plant, as well as in the refinery, Kontol corrosion inhibitors are preventing thousands of dollars worth of corrosion destruction. Kontol is not an experimental corrosion inhibitor, but has been used successfully in gasoline plants all over the country. In absorption systems less make-up oil is required since Kontol completely rids the system of corrosive products which discolor and contaminate the absorption oil. In addition to its corrosion inhibiting properties, Kontol's anti-fouling and its detergent characteristics serve to keep condensers and heat exchangers free from fouling. In many cases, the savings in cleaning costs even exceed the savings derived from corrosion prevention.

IN THE GASOLINE PLANT
KONTOL
PREVENTS CORROSION IN

- Absorbers
- Dephlegmators
- Condensers
- Cooling Coils
- Separators
- Fractionating Columns

WRITE FOR FREE BULLETIN
Lists complete technical data. Yours on request.

ASK THE MAN IN THE TRETOLITE CAR
The Tretolite engineer in your area will give you full particulars.



TRETOLITE COMPANY

A DIVISION OF PETROLITE CORPORATION
369 Marshall Avenue, Saint Louis 19, Missouri
5515 Telegraph Road, Los Angeles 22, California

KO-57-1

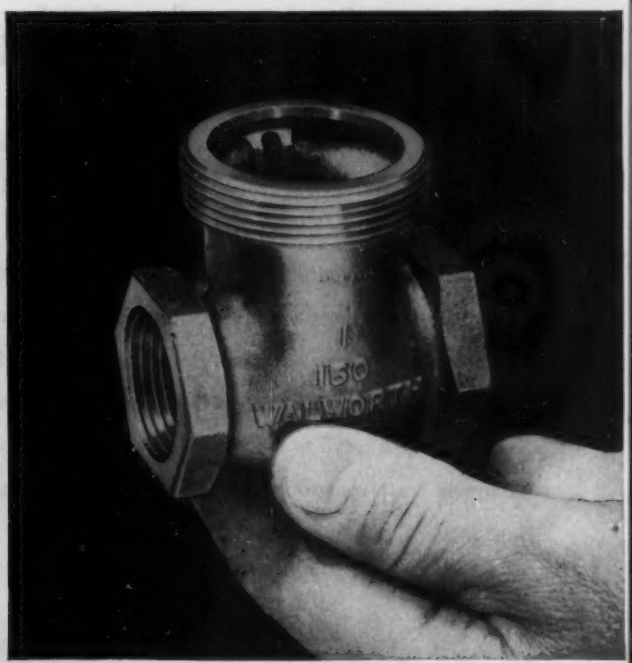
Chemicals and Services for the Petroleum Industry

DEMULSIFYING, DESALTING, CORROSION PREVENTING, WATER DE-OILING, PARAFFIN REMOVAL, SCALE PREVENTING.

For more data on advertised products, use Readers' Service Cards, last page.

Here's what makes Bronze Valves

TYPICAL OF WALWORTH QUALITY is the union body-to-bonnet connection which stiffens the body against internal pressure; makes taking the valve apart a simple operation and reduces the chances of distortion or leakage even though the valve is repeatedly taken apart and reassembled. With this type of construction there is no possibility of the bonnet coming off the valve while the handwheel is being turned.



HEAVY BODY CONSTRUCTION is typical of *all* Walworth Bronze Valves. Extra-thick walls and rugged wrench hexes constitute a high safety factor and prevent distortion while the valve is being installed in the pipeline. Extra-deep pipe threads are accurately machined to eliminate leakage. Walworth Bronze Valves are also available with flanged, silver-brazed or soldered ends in certain sizes and types.

MEET THE CHAMP! The chief engineer of a midwestern plant had used a parade of valves in severe boiler blowdown service. Most didn't last longer than 60 days. None survived 90 days.

On the recommendation of a Walworth Representative the engineer installed the Walworth No. 225P Bronze Globe Valve shown here, stating that he would be entirely satisfied if it lasted a bare three months. Exactly 4 years and 362 days later the valve was taken out of service—not due to the wire drawing, steam cutting and galling which made the other valves short-lived—but because the highly turbulent steam finally wore a small hole in the body.

This is the kind of valve satisfaction you get—when you specify and use Walworth Bronze Valves. They are the longest wearing, toughest bronze valves on the market.

Walworth Subsidiaries: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO.

Walworth *the* real bargain!

EXTRA-LARGE STEMS with extra-long, extra-deep threads prolong valve life, protect against wear and distortion and provide tight positive shutoff. The surface of the stem is machined to a glass-like finish for minimum handwheel effort and to preserve the packing which results in fewer inspections and less maintenance. The top of the stem is tapered and squared to hold the handwheel securely.

TO REDUCE WIRE DRAWING to a minimum, certain types of bronze globe valves have stainless-steel plug-type seats and discs heat-treated to a nominal hardness of 500 Brinell, adding years to valve life even in severe services. These valves can be tightly closed on sand, grit or pipe scale without damage. Seats and discs are machined simultaneously, assuring perfect mating.

There is a Walworth Bronze Gate, Globe, Angle or Check Valve for every service. Walworth is continually developing new valve types and materials, including plastics, to keep pace with the growing variety and severity of services in modern industry. For full information, see your Walworth Distributor or write: *Walworth, 60 East 42nd Street, New York 17, N. Y.*

WALWORTH

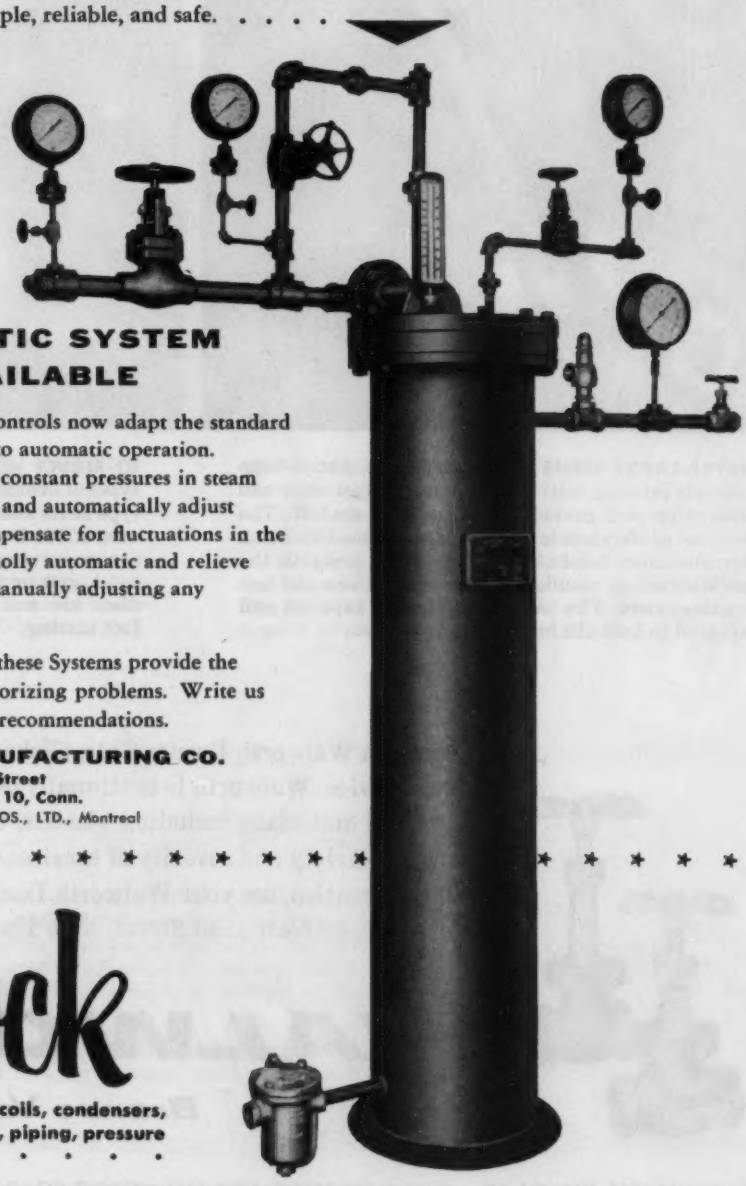
Bronze Valves and Fittings

M & H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING AND WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.

For more data on advertised products, use Readers' Service Cards, last page.

Fast, Economical Systems Convert Liquid Chlorine to Dry Vapor

When chlorine in dry gaseous form is required in relatively large quantities, Whitlock Vaporizer Systems provide high capacity output at low equipment cost. The Systems, whose design and construction were suggested by the standards of the Chlorine Institute, Inc., are standardized in design and complete packages in themselves. To operate, it is only necessary to connect steam, condensate, chlorine, and vent lines, and to insulate as required. The five standard sizes handle liquid loads in the range of 500 to 8,000 pounds per hour and provide compact, economical units for efficient operation on any installation. The controls are simple, reliable, and safe. . . . .



AUTOMATIC SYSTEM NOW AVAILABLE

New automatic controls now adapt the standard Chlorine Vaporizer System above to automatic operation. Pressure reducing valves maintain constant pressures in steam and downstream chlorine lines . . . and automatically adjust the input of liquid chlorine to compensate for fluctuations in the downstream load. Controls are wholly automatic and relieve operator of all responsibility for manually adjusting any valves for flow control.

Manually Operated or Automatic, these Systems provide the ready answer to your chlorine vaporizing problems. Write us today for further information and recommendations.

THE WHITLOCK MANUFACTURING CO.
75 South Street
West Hartford 10, Conn.
In Canada: DARLING BROS., LTD., Montreal

* *

Whitlock

Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers . . . . .

Deep in the Earth There's Another Reason Layne's on Top!

THE LAYNE IMPELLER is that reason, because a pump can be no better than its impeller.

There are two main considerations in impeller evaluation—QUALITY AND PERFORMANCE.

QUALITY—The materials used in the manufacture of a Layne impeller must be tough, durable and possess excellent *surface quality* and they must be able to insure *dimensional accuracy*. Metal patterns are used in casting high quality phosphor gear bronze into Layne impellers. Other special metals are specificed when necessary.

PERFORMANCE—A Layne impeller is correct in hydraulic design based on 75 years of Layne experience through thousands of successful installations and tests. Correct impeller design determines a pump's performance in any particular hydraulic condition.

Each Layne impeller is precision manufactured. Because no one technique is adequate, both hand finishing and special machining are used in balancing and tooling the impeller. Working to a rigid and minimum tolerance, specially designed gauges and instruments check each step to the finish of a Layne impeller . . . from water passages and angles to vane thickness.

Layne Impeller sizes range from 4" diameter and up, as specified.

The result — an impeller which operates deep in the recesses of the earth dynamically in balance. Each remaining component part of a Layne pump receives the same careful engineered attention, and when assembled assures complete pump perfection giving you years of trouble-free service.

Layne's 75 years of experience puts Layne on top!

1882 — 1957 Layne 75 YEARS OF PROGRESS

WATER WELLS • VERTICAL TURBINE PUMPS • WATER TREATMENT

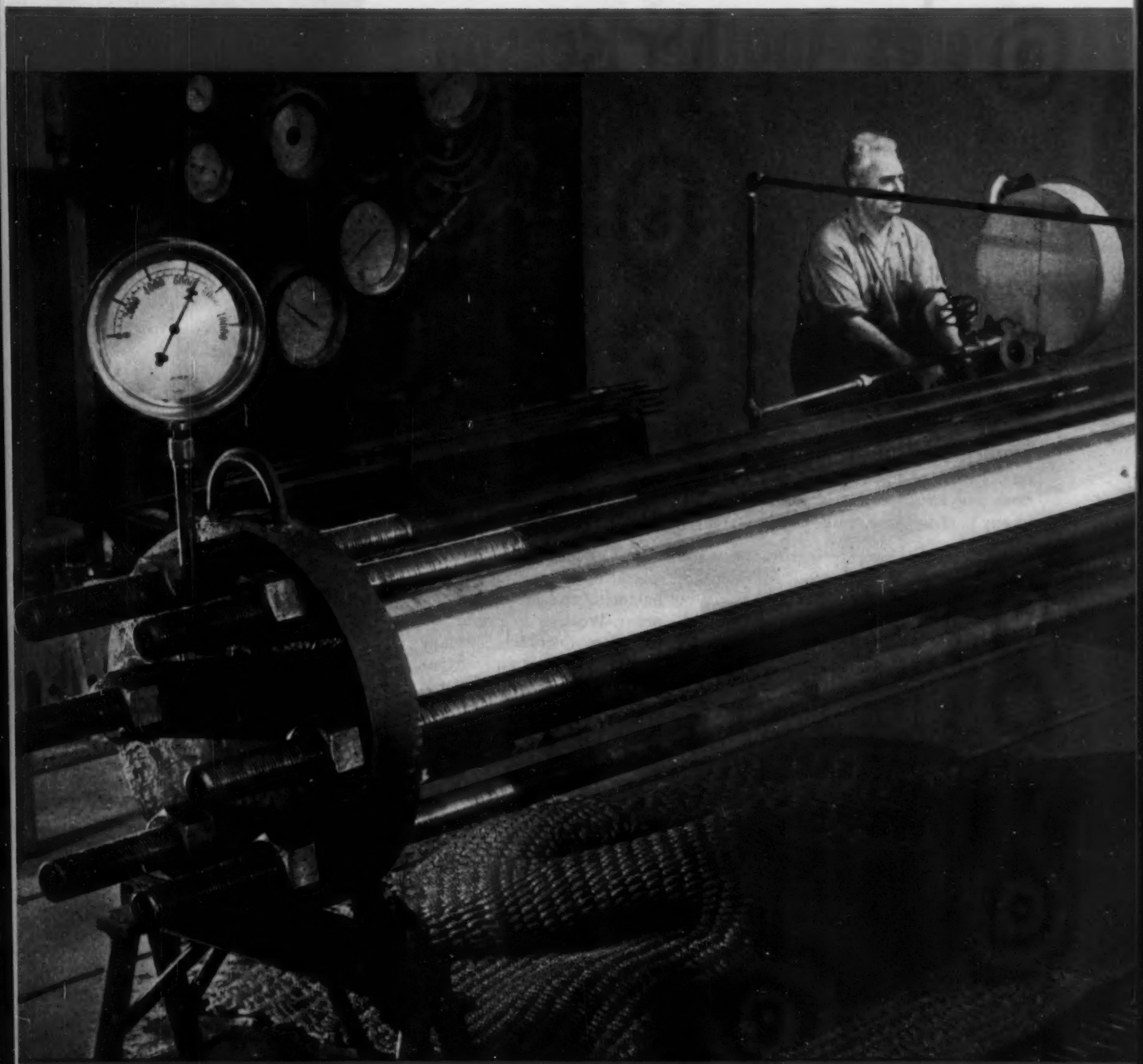
LAYNE & BOWLER, INC. MEMPHIS

General Offices and Factory • Memphis 8, Tennessee

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

THE ANSWER TO YOUR PIPING PROBLEM

STAINLESS STEEL CENTRIFUGALLY CAST MAY BE



ABOVE: Hydrostatic test rig used to qualify each length of pipe.

UNITED STATES PIPE & FOUNDRY CO.

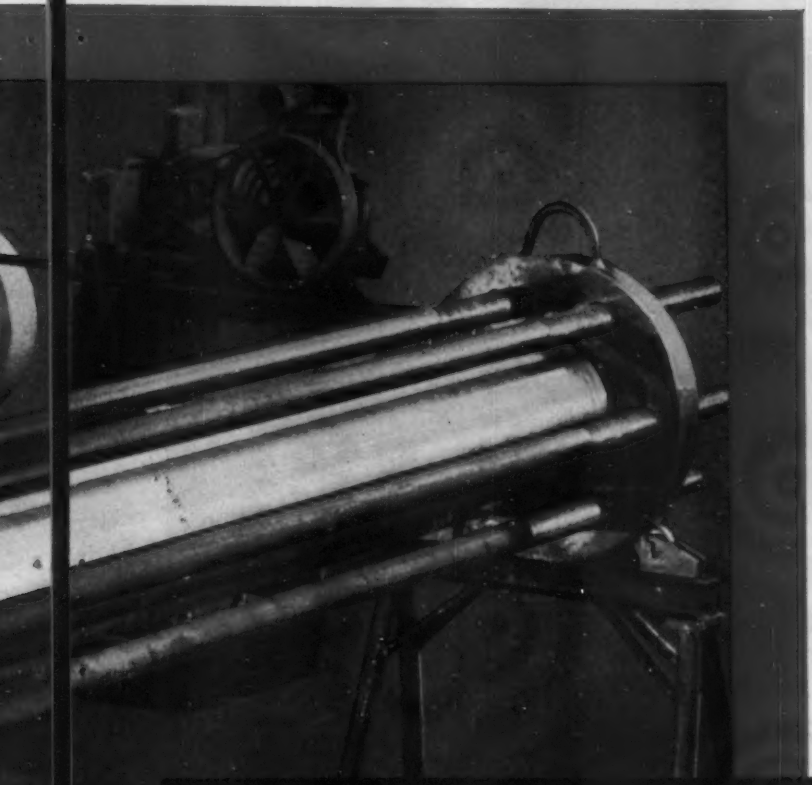
Steel and Tubes Division

STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, DETROIT, PITTSBURGH, HARTFORD, BURLINGTON

THE ANSWER TO YOUR PIPING PROBLEM



Patented U. S. Pipe process meets rigid refinery specifications

The men who design today's petrochemical plants, refineries or Atomic power plants are confronted with piping problems involving temperatures, pressures and corrosive conditions which only a few years ago would have been called impractical, if not impossible.

U. S. Pipe's Steel & Tubes Division recently completed a piping requirement for 700 feet of Type 316 Extra Low Carbon, columbium-bearing stainless for a large petrochemical plant, which is typical of the job metal mold centrifugally cast pipe is doing today under a patented manufacturing process with rigid Quality Control.

U. S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses —in large or small quantities.

Write and outline your refining problems. We may be able to help.

Note these exacting specifications on 316 Cb ELC Stainless Steel Pipe demanded by one of nation's leading oil companies:

MATERIAL REQUIREMENTS: Pipe shall conform to ASTM Specification A-362-52T.

CHEMICAL ANALYSIS: Modified AISI Type 316 Cb (ELC), with *one percent* spread on chrome and nickel.

FINISH: Each pipe to be turned, bored and faced to surface finish of 125 micro inch or better. O.D. tolerance plus 1/16″ minus 0″; I.D. tolerance plus 0″ minus 1/32″. Pipe size: 12″ O.D. × 1.17″ wall.

MECHANICAL TESTS: Tensile Tests — 2 tests required on each pipe after heat treatment; one at room temperature, one at 700° F.

INSPECTION REQUIREMENTS

1. Etching test on sections cut from each end of pipe.
2. Radiographic Inspection — Required complete circumferential coverage of at least an 8″ wide section at each end of each pipe in accordance with ASTM Specification E71-52.
3. Fluid Penetrant—Entire O.D. and I.D. surface each piece.

HEAT TREATMENT: Heat for 4 hours at 2100° F.—2150° F., water quench, follow by 5 hours at 1500° F.—1600° F. Cool in still air.

HYDROSTATIC TEST: Each length tested to stress of either 90% of the minimum cold yield strength or a maximum pressure of 6800 psi —whichever is lower.

SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter—6″ to 50″
Wall Thickness—⅜″ and up
Length—Up to 16′
Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E.L.C. grades.

Let Harshaw Catalysts do a GIANT'S work for you

Harshaw Catalysts do a giant's work and Harshaw produces catalysts in giant quantities—carloads every week. A letter or phone call will put our 20 years' experience and acres of production and research facilities to work for you.

TABLETS

SPHERES

EXTRUSIONS

GRANULES

POWDERS

FLAKES

PREFORMED CATALYSTS
to fit special process requirements

Hydroforming
Cyclization
Oxidation
Dehydrogenation
Dehydration
Desulphurization
Alkylation
Isomerization
Hydrogenation

CATALYTIC CHEMICALS SUPPLIED BY HARSHAW

Aluminum Nitrate — Cobalt Nitrate
Copper Nitrate — Manganese Nitrate Solution
Metallic Soaps (Cobalt, Manganese)
Nickel Carbonate — Nickel Formate — Nickel Nitrate
Nickel Sulfate — Sodium Methoxide — Zinc Nitrate

Our experienced technical staff will assist you in developing the best and most economical catalyst. If you have a catalytic process in the development or production stage, a discussion with us may prove beneficial.

Write for Free Book

THE HARSHAW CHEMICAL CO.
Chicago • Cincinnati • Cleveland • Detroit • Hastings-On-Hudson
Houston • Los Angeles • Philadelphia • Pittsburgh

No. 20 Alloy, 17-4 P H, 17-7 P H and E.L.C. grades.

TRECO—CONTRACTOR TO AMERICA'S FAMOUS REFINERS*

The REFINERY ENGINEERING Company is proud to have served the majority of America's best-known refiners in the field of Engineering, Design and Construction. Each year sees our list of satisfied clients expanding.

Back of this steady expansion is the satisfactory completion of each contract on, or ahead of time; the ease and economy of operation of the plant as well as the small amount of "down time."

Treco has purchased a tract of land, in excess of three acres. This new facility provides more than 14,000 square feet of air-conditioned offices with paved parking for over 200 cars. There is also a cafeteria building and two other buildings of 9,700 feet and 37,000 feet of space for expanding Treco activities.

* The Trade Marks above are of the companies Treco has recently served.

The REFINERY ENGINEERING Company has just produced a brochure which shows the Company's facilities with photographs of completed projects. A copy will be mailed you promptly upon request on your company's letterhead.

ESSO STANDARD OIL COMPANY

McCOLL-FRONTENAC OIL COMPANY, LTD.

PHILLIPS PETROLEUM COMPANY

CONTINENTAL OIL COMPANY

SHELL OIL COMPANY

THE TEXAS COMPANY

SINCLAIR REFINING COMPANY

COSDEN PETROLEUM CORPORATION

D-X SUNRAY OIL COMPANY

ROYALITE OIL COMPANY, LTD.

KERMAC

KERR-McGEE OIL INDUSTRIES, INC.

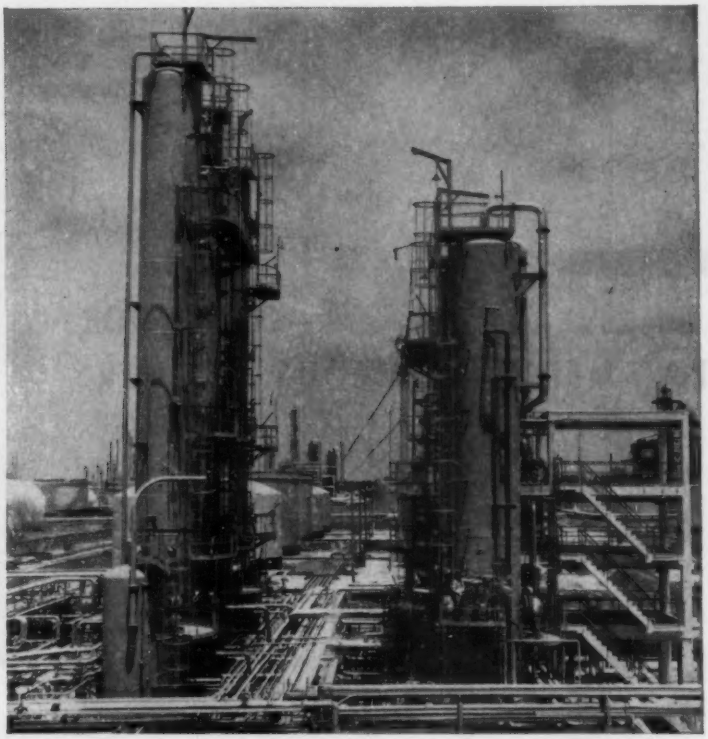
TRECO

A DIVISION of VITRO CORPORATION of AMERICA

The REFINERY ENGINEERING Company

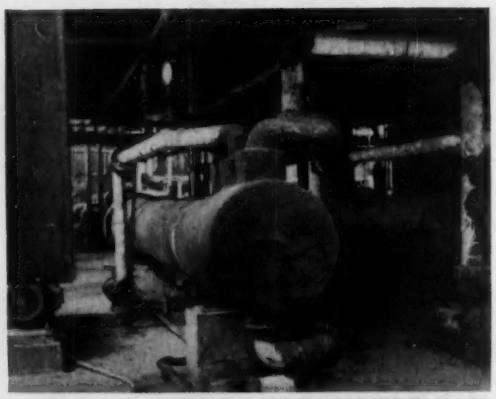
NEW YORK TULSA TORONTO

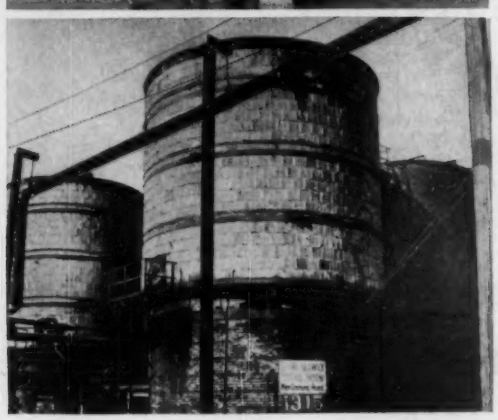
For more data on advertised products, use Readers' Service Cards, last page.



Take towers — This one is saving a large southern refinery $20,000 a year in maintenance costs. Solid 7/16-in. Monel* nickel-copper alloy walls save the caustic stripping tower in the refinery's Unisol unit from the corrosive bite of 47° Baume caustic at 290° to 300°.

Experience spurs use of Monel for handling caustics





Heat exchangers (left) — Here's a preheater that is exposed to contaminated caustic entering the regenerator tower and to pure caustic leaving. Despite severe conditions, the preheater is giving trouble-free service. Shell and tubes are Monel alloy.

Agitators (lower left)—In this large agitator tank at an eastern refinery, bottoms and sides up to 6 ft. were replaced with Monel alloy. A wise choice. Monel alloy has proved to be the most economical material to use for this service.

Experience like this has led to the use of Monel alloy for a variety of other caustic processing units: reboiler tube bundles, hot caustic lines and caustic storage vessels, to name a few. In petrochemical plants using caustics, Monel alloy guards product purity.

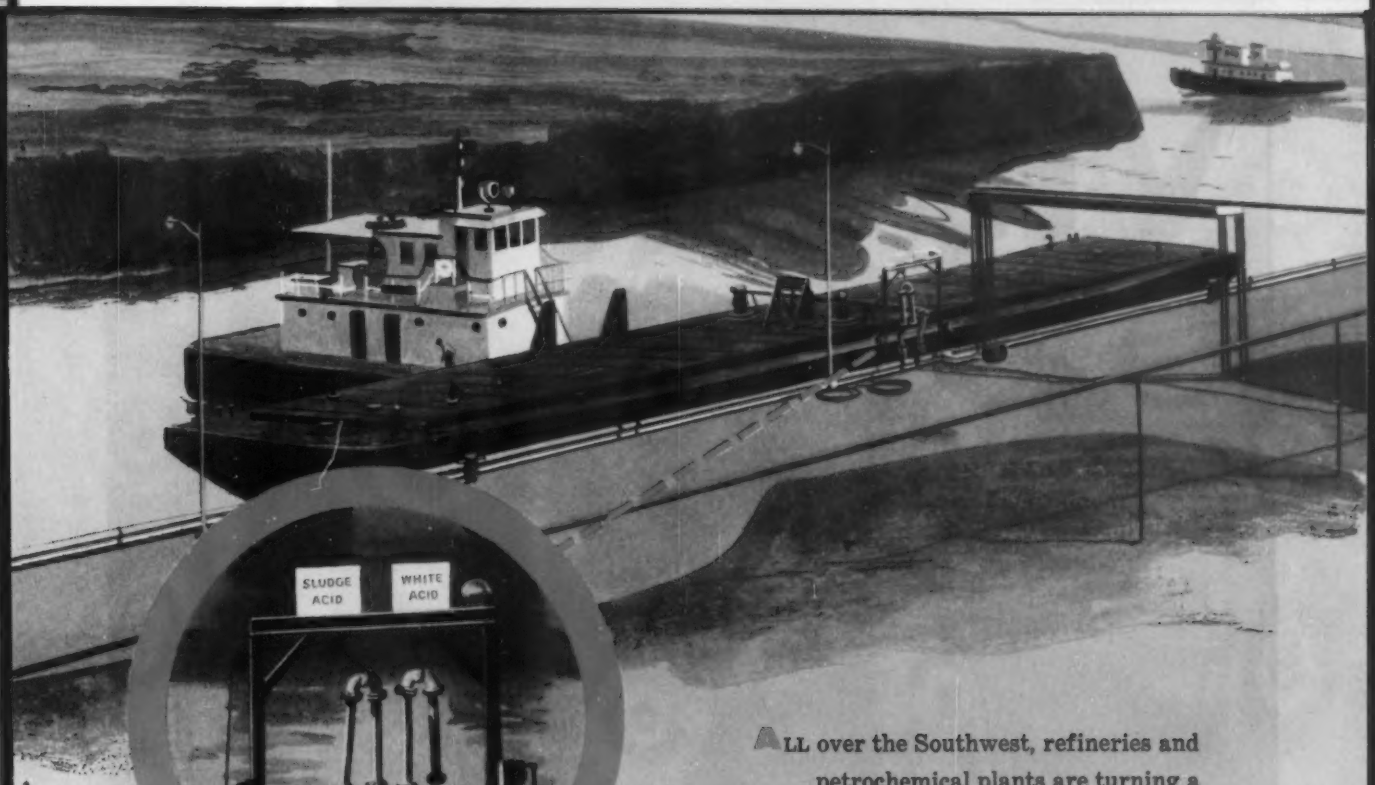
Making available field experience in overcoming caustic corrosion is one of Inco's many services. Why not take advantage of this service? Send us details of your problem and our Research and Development Engineers will work with you to provide a solution.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Nickel Alloys**

Monel... *for minimum maintenance*



PROFIT FROM WASTE

with Consolidated's sludge acid regeneration service

ALL over the Southwest, refineries and petrochemical plants are turning a disposal problem into an asset by shipping their spent acids to one of Consolidated Chemical Industries' five sulphuric acid recovery plants. Here even the heaviest sludges, with the lowest per cent of free acid, are turned into fresh, white 99% product on a contract basis. Shipments are handled by road, rail or water.

This acid regeneration service is in keeping with Consolidated's leadership in the manufacture of sulphuric acid and allied chemical raw materials. Whether your requirements are for a fast, dependable source of new acid or for a method of turning past waste into future profit, you can depend on CCI—the *big* name in sulphuric acid in the Gulf Southwest. Write for complete information.

Stauffer CHEMICALS SINCE 1885

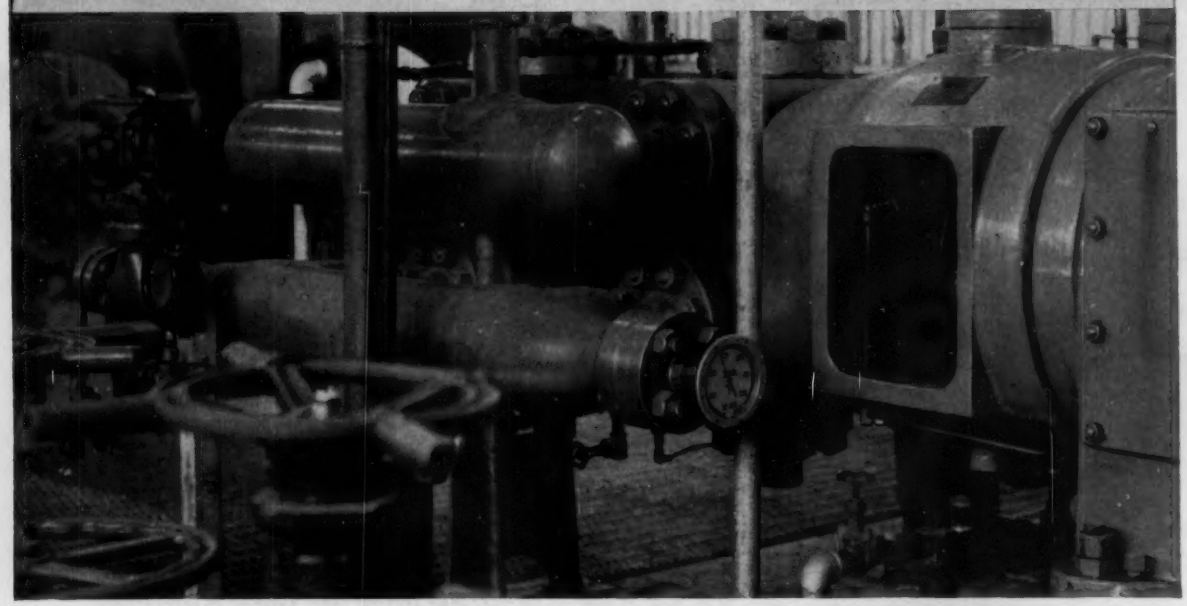
CCI

CONSOLIDATED CHEMICAL INDUSTRIES

DIVISION OF STAUFFER CHEMICAL COMPANY

640 Esperson Building, Houston 2, Texas • 380 Madison Avenue, New York 17, N. Y.

VIBRATION



Vibration of refinery compressor proves unshakable accuracy of RMC thermometer

The RMC Thermometer shown in the photograph is constantly subjected to extreme vibration from the two-stage Synthesis Gas Compressor on which it is installed. This powerful equipment is used to compress a mixture of H_2 and N_2 from 400 to 3500 pounds—at the Philadelphia Synthetic Ammonia Plant of The Atlantic Refining Company.

This particular job required a special thermometer that could withstand the constant and terrific vibration, and at the same time provide and maintain precise, accurate readings. Rochester Manufacturing Company promptly came up with the answer—a silicone-dampened, bimetallic, angle-form RMC thermometer. And this is but one example of how RMC engineering skill provides instruments that meet the most demanding and exacting requirements.

Look to RMC for Full-Line Instrumentation

DIAL THERMOMETERS

Illustrated here is a 6" dial thermometer with hermetically sealed dial chamber, external recalibration—built for heavy duty service. What are your thermometer requirements?

PRESSURE SWITCHES

This RMC Pressure Switch will stand heavy pulsating pressures, has close on-off differentials, maintains consistent cut-in, cut-out settings. What are your pressure switch problems?

TELL US YOUR REQUIREMENTS FOR DIRECT MOUNTING AND REMOTE INDICATING INSTRUMENTS, AND LET RMC ENGINEERING SKILL PROVIDE THE ANSWERS!

REPRESENTATIVES IN ALL PRINCIPAL CITIES

RMC

"You Can Rely On Rochester"

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

ROCHESTER MANUFACTURING CO., INC.
38 ROCKWOOD STREET • ROCHESTER 10, N.Y.

©1956 Rochester Manufacturing Co., Inc.

For more data on advertised products, use Readers' Service Cards, last page.

Unique combination of fine engineering and economy!

...the new FOXBORO M/44 INDICATING PRESSURE TRANSMITTER

- **Easier to Read . . . large indicator scale, visible at 20 ft.**
- **Easier to Calibrate . . . simple adjustments "on location"**
- **More Compact . . . single, integral instrument**

Any way you look at it, the new Foxboro M/44 Pneumatic Pressure Transmitter gives you an unmatched combination of fine engineering and economy. First; because it *is* an engineered instrument. There are no attachments or "makeshifts". Second; because it utilizes standard Foxboro parts throughout—parts which have been performance-proved in thousands of successful installations of other Foxboro Instruments. And this means not only top performance, but easier servicing and stocking as well. Third; calibration is simple, right in the field, because the M/44 is "convenience-designed" by men with years of experience in every phase of instrument design and application.

In appearance, too, the M/44 has unmistakable Foxboro quality. Features like the high-legibility indicator scale, the compact drawn-steel case with tough polyester plastic cover. It's the neat, high-efficiency, low-cost pressure transmitter for centralized operation or control. All standard ranges.

Write for complete details

THE FOXBORO COMPANY
744 Neponset Avenue, Foxboro, Mass.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

FOXBORO
REG. U.S. PAT. OFF.
INSTRUMENTATION FOR INDUSTRY

For catalytic reforming...

Forty refineries specified Clark

User	*Location*	*No. of Units*
Atlantic Refining Company, The	Point Breeze, Pennsylvania	2
BP Refinery (Kent) Ltd.	Kent, England	1
Burmah-Shell Refineries Ltd.	Bombay, India	1
Bahrain Petroleum Company, Ltd., The	Bahrain, Persian Gulf	1
Caltex Petroleum Maatschappij N.V.	Pernis, Holland	1
Compagnie Francaise de Raffinage	La Mede, France	1
Gulf Oil Corporation	Girard Pt., Pennsylvania	4
Gulf Oil Corporation	W. Pt. Arthur, Texas	4
*	Eastern Canada	1
McColl-Frontenac Oil Company Limited	Montreal, Canada	1
Ohio Oil Co., The	Robinson, Illinois	1
Phillips Petroleum Company	Phillips, Texas	1
Phillips Petroleum Company	Kansas City, Kansas	1
Pure Oil Company, The	Smith Bluff, Texas	1
Refineria de Petroleos de Escombreras, S.A.	Cartagena, Spain	2
Shell Oil Company	Wood River, Illinois	2
Shell Oil Company	Deer Park, Texas	1
Shell Oil Company	Houston, Texas	2
Shell Oil Company	Anacortes, Washington	1
Shell Oil Company of Canada Limited	Montreal, Canada	1
Shell (Refining) Australia Pty. Ltd.	Geelong, Australia	1
Sinclair Refining Company	Marcus Hook, Pennsylvania	2
Sinclair Refining Company	E. Chicago, Illinois	2
Societe Francaise des Petroles BP	Dunkirk, France	1
Societe Industrielle Belge des Petroles	Antwerp, Belgium	1
Socony Mobil Oil Company, Inc.	Paulsboro, New Jersey	1
Societe per l'Industria Italiana del Petrolio	La Spezia, Italy	1
Standard Oil Co. of California	El Segundo, California	2
Standard Oil Co. of California	Richmond, California	2
*	Central Kansas	1
Standard Oil Co. of Ohio	Toledo, Ohio	2
Sun Oil Company	Toledo, Ohio	1
D-X Sunray Oil Company	Tulsa, Oklahoma	1
Suntide Refining Company	Corpus Christie, Texas	2
Texas Company, The	Wilmington, California	1
Texas Company, The	Laurenceville, Illinois	2
Texas Company, The	Westville, New Jersey	2
Texas Company, The	Pt. Arthur, Texas	5
Tidewater Oil Company	Delaware City, Delaware	1
Wilshire Oil Co. of California	Norwalk, California	2

*Name furnished on request

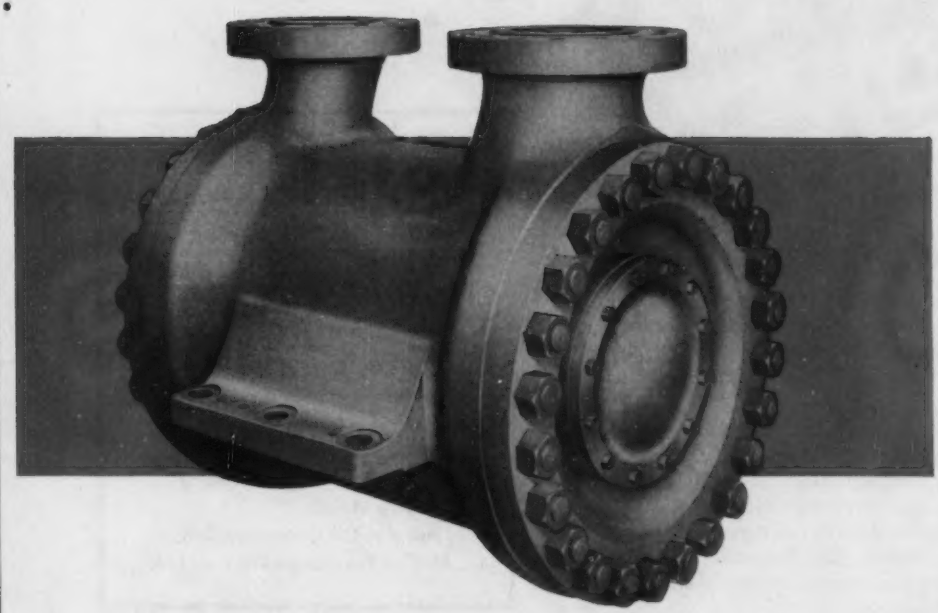
60% choose Clark

Vertically-split centrifugal compressors

Forty major refineries are using or have ordered Clark vertically-split centrifugal compressors for their reforming needs. That's over 60% of the total requiring centrifugal compressors.

We could mention many reasons why these Clark units outsell all other makes combined, but we prefer to let the facts speak for us. Remember 6 out of 10 are Clark . . . how about your next reformer?

CLARK BROS. CO., OLEAN, N. Y.
One of the Dresser Industries
Offices in Principal Cities throughout the World



CLARK® Centrifugal Compressors

For more data on advertised products, use Readers' Service Cards, last page.

Bingham

"KOKE-KRUSHER" HOT OIL PUMP

NON-CLOGGING!

PULVERIZES LARGE PIECES OF ENTRAINED COKE IN PUMPAGE

Bingham Type CKM
"Double Volute", Two Stage,
"KOKE-KRUSHER" for handling
hot, coke-laden pumpage at high heads.

- Results in more hours on stream—less down time.
- The pulverizing action on entrained solids reduces clogging of other system equipment.
- Non-pulsating flow eliminates need of auxiliary equipment for control of pressure and/or capacity.
- Eliminates expensive protective devices.
- Smooth pump characteristics eliminate destructive vibration.
- Lower maintenance. Only one moving part.

HANDLES COKE-LADEN HOT OIL IN CRACKING SYSTEMS WITHOUT CLOGGING

The Bingham "Koke-Krusher", the only pump that crushes coke, is a field-proven, centrifugal pump specially designed for the severe services of pumping oil products such as *Residuum, Flash Tower Bottoms, Black Oil Recycle*—in which the oil carries in suspension pieces of hard coke of irregular size and shape.

This revolutionary Bingham pump features a coke crushing mechanism located in the suction chamber immediately in front of the impeller eye. Any piece of solid coke entrained in the pumpage *must* pass through the crusher, where it is instantly pulverized, before entering the impeller.

The resulting pulverized coke particles are small enough to assure free flow through the pump and all system equipment. The Bingham "Koke-Krusher" will make a big difference in your operations. Call your nearest Bingham office for full details. Send for Bulletin 106.

PARTIAL LIST OF MAJOR OIL COMPANIES WITH BINGHAM KOKE-KRUSHER PUMPS IN OPERATION OR ON ORDER

ESSO Standard Oil Company
Gulf Oil Company
Texas Oil Company
Canadian Petrofina, Ltd.
Champlin Refining Company
Shell Oil Company
Sinclair Refining Company
Socony Mobil
Imperial Oil Company, Ltd.
McColl Frontenac Oil Co., Ltd.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY

General Offices: **2800 N.W. Front Avenue, Portland 10, Oregon**

Factories: **Portland, Ore. • Vancouver, B. C., Canada**

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DENVER, COLO. — SEATTLE, WASH.
HOUSTON, TEXAS — ST. LOUIS, MO.
KANSAS CITY, MO. — ST. PAUL, MINN.
LOS ANGELES, CALIF. — TULSA, OKLA.
NEW ORLEANS, LA. — TORONTO, ONT., CAN.
VANCOUVER, B. C., CAN.

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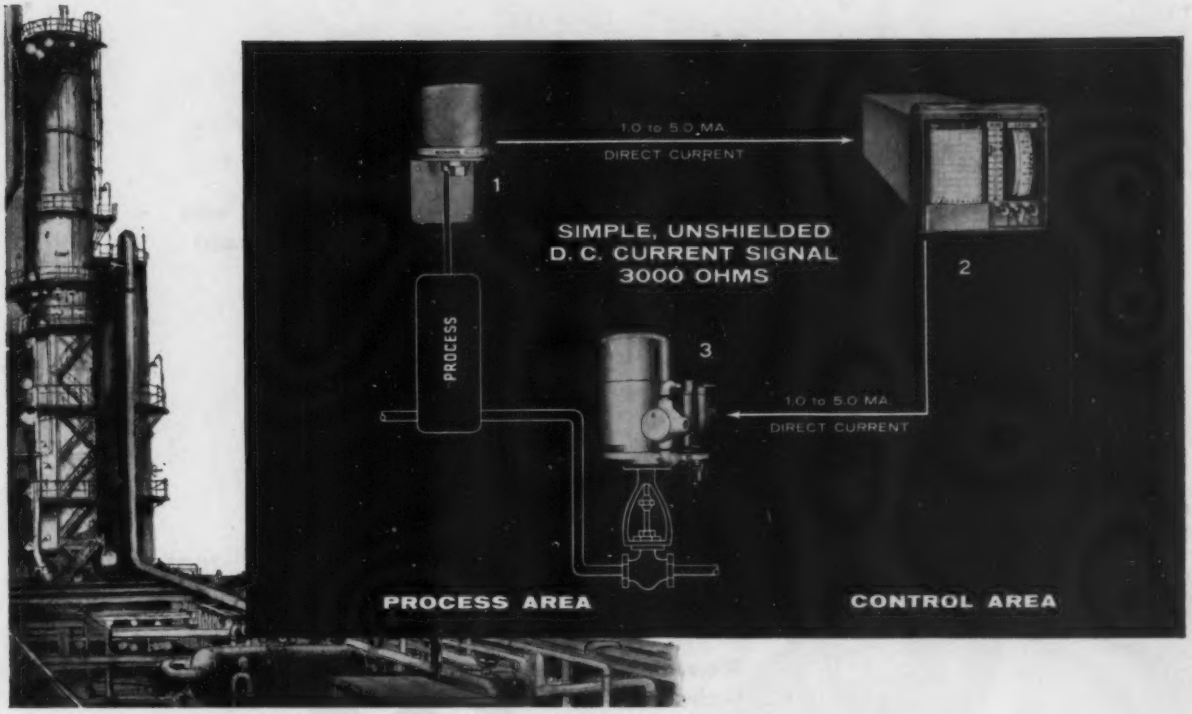


Let's look at a typical control loop of the 'American-Microsen' *ELECTRONIC PROCESS CONTROL SYSTEM*

This all-electronic dc system of miniature-type units assures the instrument engineer of 1) better control; 2) greater flexibility; 3) lower initial costs; 4) lower operating costs. The typical control loop above demonstrates the simplicity and functions of the system.

1. *Transmitter.* 'American-Microsen' transmitters are used for measuring pressure, temperature, differential pressure, liquid level, flow, and other process variables. The "Microsen" balance creates a stable dc signal for long distance transmission. Transmitters have no bearing pivots or linkages — assuring sensitivity and repeatability of measurement. Small size is made possible by printed circuitry and miniaturized components. The unit can be installed on meter piping, pipe pedestal or vertical surface.

2. *Controller.* A single unit combines all functions of measuring and recording or indicating the input signal; producing the control signal; and allowing manual-automatic process operation. Separate plug-in chassis provides the following functions: *A.* Records or indicates process variable. Strip or card chart recorder chassis available. *B.* Produces proportional, reset and rate control actions to regulate the variable. All control settings are calibrated. *C.* Permits switching to manual operation during start-up or emergency conditions, with true "bumpless" transfer from manual to automatic control.

Transistorized design increases reliability and service life. Miniaturization and consolidation of control functions reduces panel cost and wiring expense.

3. *Electro-Hydraulic Control Valve Operator.* A power unit with position feedback that operates slip-stem control valves. No compressed air is needed. Mountable on standard yokes supplied with conventional slip-stem control valves with bodies of single or double-seated construction, with V-port, parabolic, needle and equal percentage plugs, including valves of 4" stroke, and force available up to 3,250 lbs.

Where required, the American-Microsen Electro-Pneumatic Valve Positioner or the Electro-Pneumatic Transducer can be supplied.

In automating your processes for higher product quality and greater operating economy, you want the better control and simplified servicing provided by the American-Microsen Electronic Process Control System. We invite you to meet with one of our sales engineers to determine the best equipment for your service. Write for literature.

MANNING, MAXWELL & MOORE, INC.

MAXWELL MANNING & MOORE INC. M&M TRADE MARK

INDUSTRIAL CONTROLS DIVISION • STRATFORD, CONNECTICUT

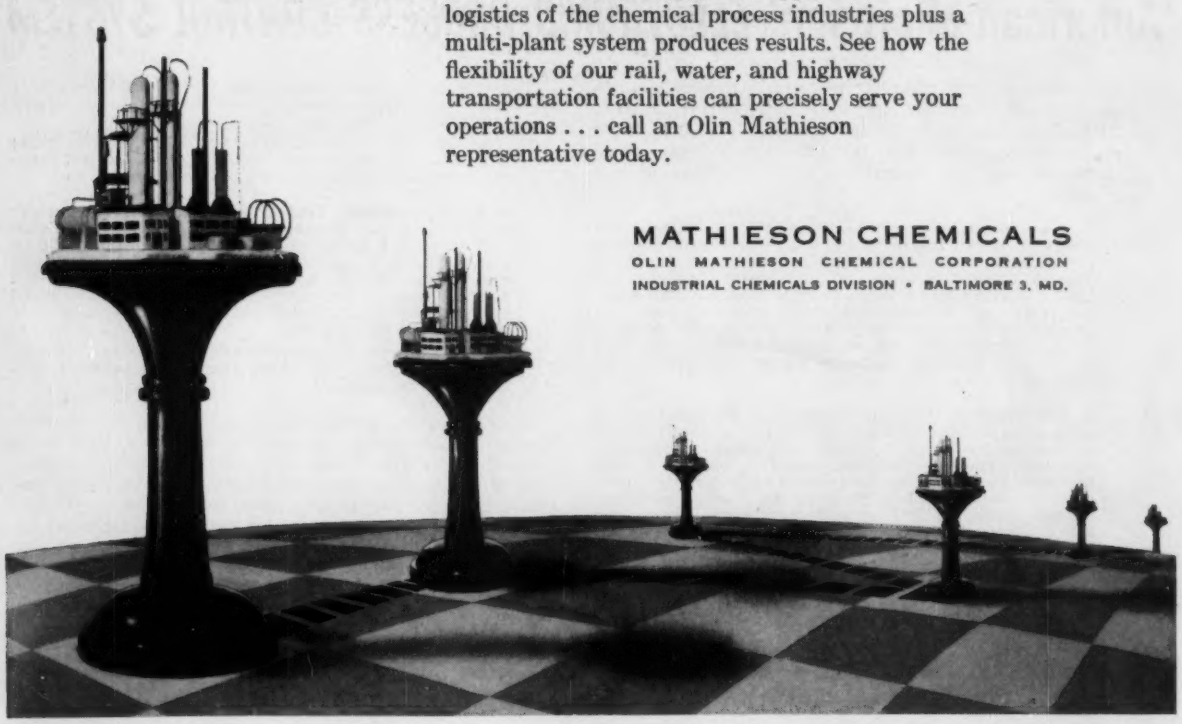
MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC INSTRUMENTS FOR MEASUREMENT, TRANSMISSION AND CONTROL

For more data on advertised products, use Readers' Service Cards, last page.

ubiquitous chemicals

Where needed, when needed—maximum dependability of chemical supply is best assured by a multi-plant set-up. It smooths out local shortages and surpluses . . . assures you of shipments on schedules that meet your most exacting requirements.

Olin Mathieson's imaginative approach to the logistics of the chemical process industries plus a multi-plant system produces results. See how the flexibility of our rail, water, and highway transportation facilities can precisely serve your operations . . . call an Olin Mathieson representative today.

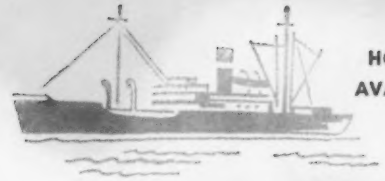


MATHIESON CHEMICALS
OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

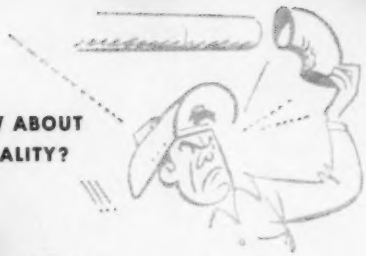
MATHIESON

INORGANICS: Ammonia • Bicarbonate of Soda • Carbon Dioxide • Caustic Potash • Caustic Soda • Chlorine • Hydrazine and Derivatives • Hypochlorite Products Muriatic Acid • Nitrate of Soda • Nitric Acid • Soda Ash • Sodium Chlorite Products • Sulphate of Alumina • Sulphur (Processed) • Sulphuric Acid • **ORGANICS:** Ethylene Oxide • Ethylene Glycols • Polyethylene Glycols • Glycol Ether Solvents • Ethylene Dichloride • Dichloroethylether • Formaldehyde • Methanol • Sodium Methylate Hexamine • Ethylene Diamine • Polyamines • Ethanolamines • Trichlorophenol

4688



HOW ABOUT AVAILABILITY?

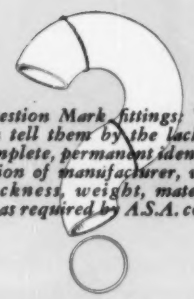


HOW ABOUT QUALITY?

HOW ABOUT IDENTIFICATION?

HOW ABOUT YOUR REPUTATION?

Why try to cut corners with Question-Mark* fittings?



**Question Mark fittings: You can tell them by the lack of complete, permanent identification of manufacturer, wall thickness, weight, material . . . as required by A.S.A. code.*

Unknown welding fittings are as risky as unmarked turns on a busy highway. These blind spots in an expensive piping project cause slow-downs, confusion, trouble . . . waste time and money.

"Question Mark" fittings may look like a bargain on the price tag, but watch out for the after-costs . . . poor fit-up, impaired quality, questionable supply, lack of engineering service! Your reputation is at stake!

A message in the interests of top quality piping . . .
by Tube Turns, Louisville, Kentucky.

HOW TO SAFEGUARD YOUR REPUTATION

He knows he's getting the exact fitting specified on the blueprint because each TUBE-TURN product is clearly marked with all designations.

Save manhours...avoid piping risks with known fittings

You save purchasing time, get prompt delivery, speed up installation, and help assure reliable piping performance when you specify TUBE-TURN* Welding Fittings and Flanges. They meet all American Standard and Safety Code requirements. Each product is permanently marked with complete size and material designation. Your nearby Tube Turns' distributor gives you prompt delivery from the complete-line stock, and makes available Tube Turns' unmatched engineering service.

You *know* your piping investment is safeguarded when you specify and buy Tube Turns' products.

Your nearby Tube Turns' Distributor meets your needs promptly from the complete line of more than 12,000 Tube Turns' stocked items.

The Leading Manufacturer of Welding Fittings and Flanges

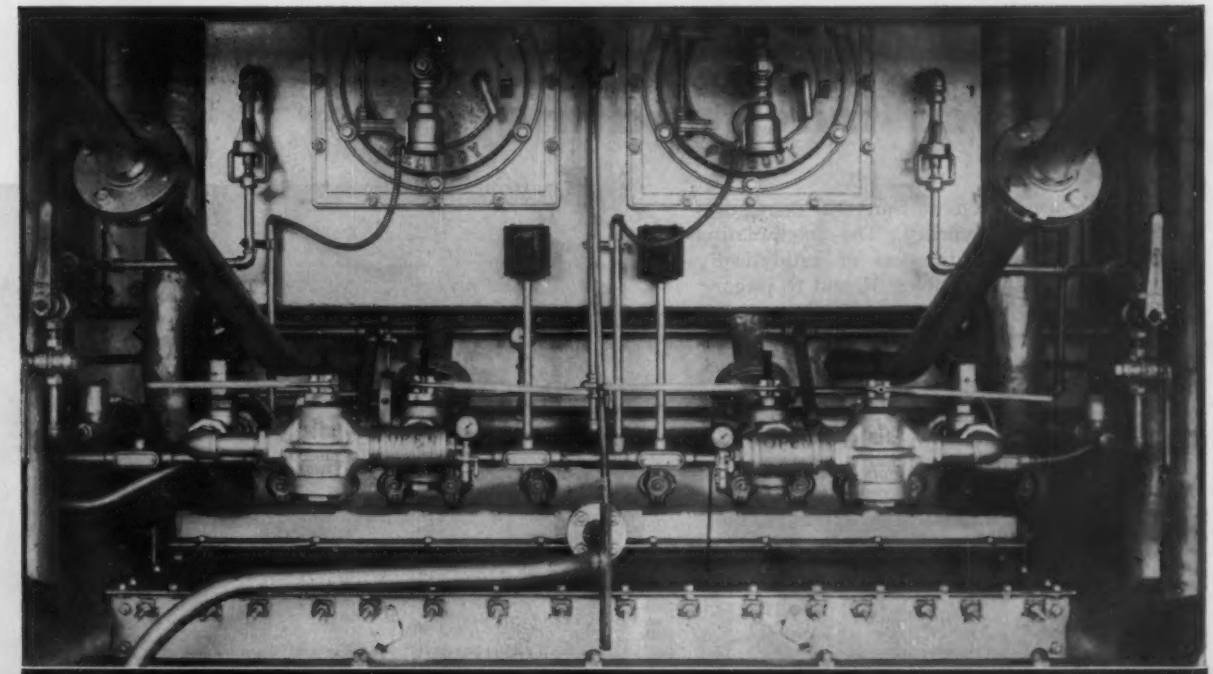
TUBE TURNS

LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland
Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle
In Canada: Tube Turns of Canada, Ltd., Ridgetown, Ontario • Toronto, Ontario • Edmonton, Alberta

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.



controlling gas to furnaces and boilers...

AN IMPORTANT JOB DONE BY

HOMESTEAD *lubricated* PLUG VALVES

AT A. B. DICK COMPANY, CHICAGO

An analysis of numerous types of valves convinced the A. B. Dick Company that HOMESTEAD Lubricated PLUG VALVES were well suited for use on gas lines to furnaces and boilers in their Chicago, Illinois plant. In fact, there are more than 5,000 Homestead Valves of various types in this plant. Satisfactory performance from the valves they have chosen is guaranteed by built-in features such as:

1. 100% Pipe Area—streamlined ports—minimum resistance to flow —minimum pressure drop.
2. Controlled Pressurized Lubricant System prevents sticking, by instant piston-like movement of plug at start of lubrication.
3. Extruded lubricant around stem indicates system is full; serves as stop signal to prevent overlubrication. No clogging of low pressure lines with lubricant, fouling of meters, orifices, etc.
4. Triple Head Seal—two rings of lubricant and reinforced Teflon stem seal. Stem seal holds pressure even without lubrication.

. . . plus many others. To know the meaning of real valve economy and service, install a few of these valves under your own service conditions. You'll be glad you did.

Your copy of Valve Reference Book No. 39-5 showing Homestead Lubricated Plug Valves will be sent on request.

Please mail, without obligation, Valve Reference Book No. 39—Section 5.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

HOMESTEAD VALVE MANUFACTURING COMPANY

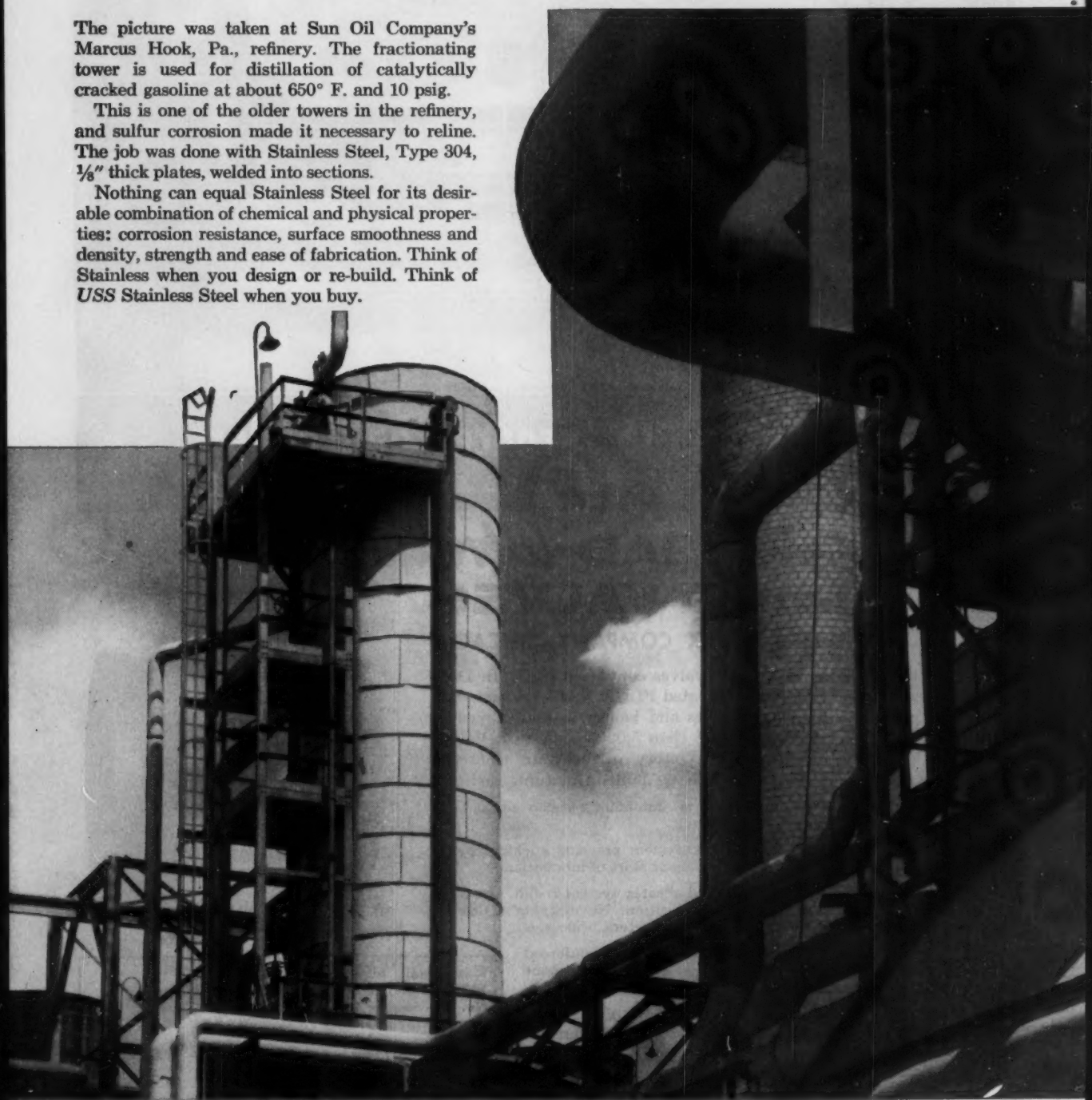
P. O. BOX 45 *"Serving Since 1892"* CORAOPOLIS, PA.

Stainless Steel reduces sulfur corrosion in Sunoco fractionating tower

The picture was taken at Sun Oil Company's Marcus Hook, Pa., refinery. The fractionating tower is used for distillation of catalytically cracked gasoline at about 650° F. and 10 psig.

This is one of the older towers in the refinery, and sulfur corrosion made it necessary to reline. The job was done with Stainless Steel, Type 304, ⅛" thick plates, welded into sections.

Nothing can equal Stainless Steel for its desirable combination of chemical and physical properties: corrosion resistance, surface smoothness and density, strength and ease of fabrication. Think of Stainless when you design or re-build. Think of *USS* Stainless Steel when you buy.



UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS STAINLESS STEEL

SHEETS • STRIP • PLATES • BARS • BILLETS • PIPE • TUBES • WIRE • SPECIAL SECTIONS

2-2800

UNITED STATES STEEL

because of GLYCOLS *and* ETHANOLAMINES

Wet or sour gases, once flared as a nuisance, now produce millions in revenue — thanks to the glycols and ethanolamines. If you use these versatile chemicals for gas dehydration or purification, you want to be sure of steady supply and instant service. Allied glycols and ethanolamines are available in tank car lots from Nitrogen Division's Orange, Texas plant, and in tank trucks or drums from warehouses in principal producing areas. Allied's technical specialists are always on call to help with any application problems you may have.

Dept. GA 1-21-1

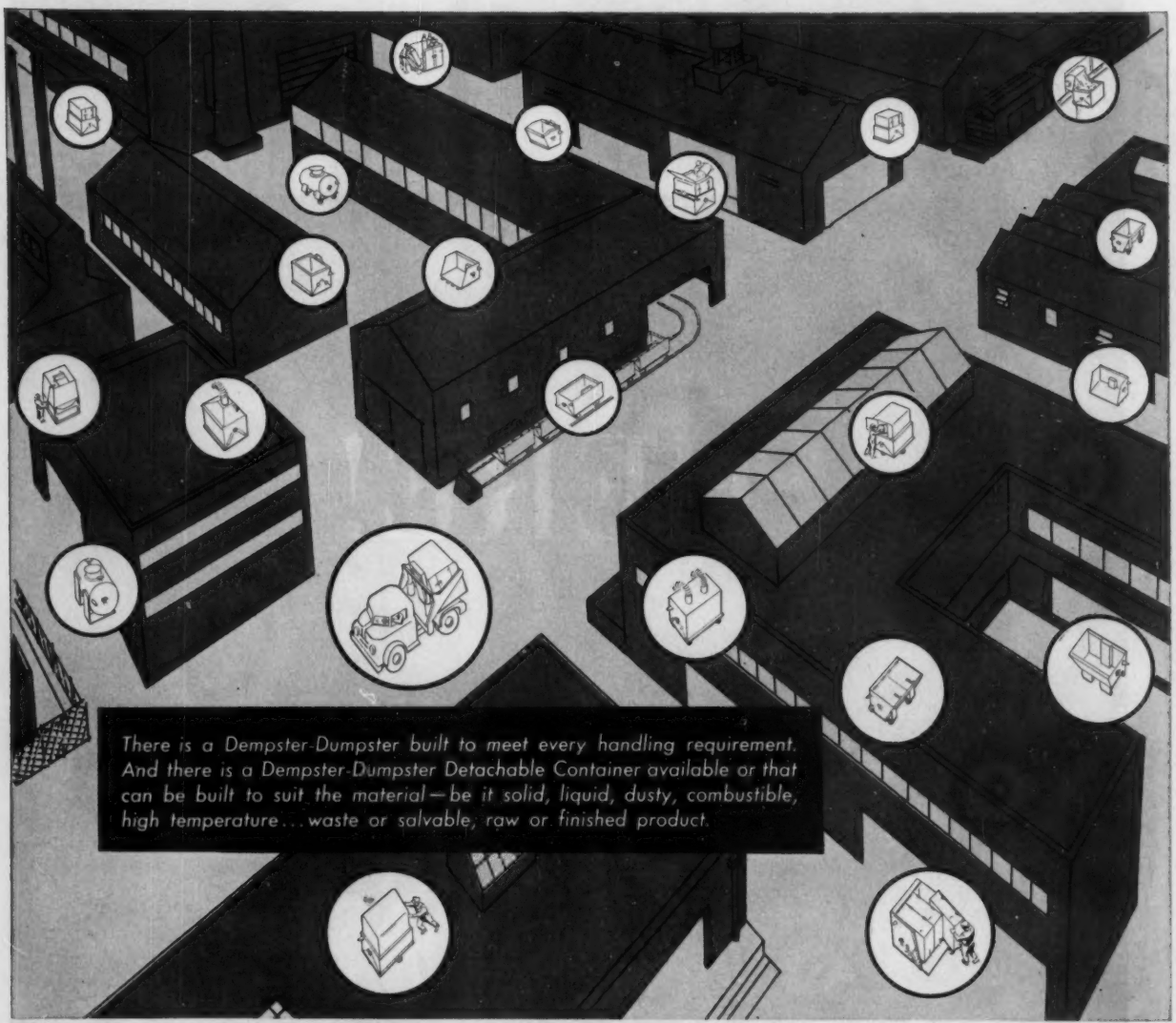
Allied Chemical — Nitrogen Division

40 Rector Street, New York 6, N. Y.

Ethanolamines • Ethylene Oxide • Ethylene Glycols • Urea • Formaldehyde • U. F. Concentrate—85 • Anhydrous Ammonia • Ammonia Liquor • Ammonium Sulfate • Sodium Nitrate • Methanol • Nitrogen Solutions • Nitrogen Tetroxide • Fertilizers & Feed Supplements

For more data on advertised products, use Readers' Service Cards, last page.

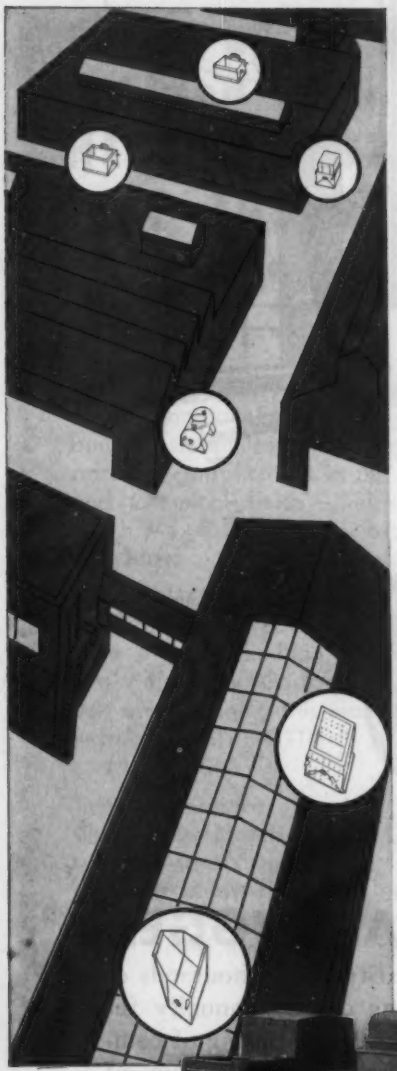
Who else wants to reduce materials


There is a Dempster-Dumpster built to meet every handling requirement. And there is a Dempster-Dumpster Detachable Container available or that can be built to suit the material—be it solid, liquid, dusty, combustible, high temperature... waste or salvable, raw or finished product.

With only one man, the driver, one Dempster - Dumpster serves scores of big detachable steel containers -- sizes 2 to 21 cu. yds... payloads up to 36,000 lbs!

SERVING COST-MINDED MANAGEMENT ALL OVER THE WORLD

handling cost 60% to 80% ? . . .



A FACT-FINDING SURVEY made by one of our engineers in cooperation with officials at one relatively small plant revealed labor cost of that firm's then-present-method was $6,552.00 annually. Labor cost would be $1,160.00 with the Dempster-Dumpster System — a saving of $5,392.00 annually (82 cents out of each $1.00). Investment in our equipment would amount to $10,000.00. In less than two years the equipment would pay for itself from its own savings produced for the user.

Results of a survey at a larger plant revealed annual labor cost amounted to $64,119.00, and would be $23,304.00 with the Dempster-Dumpster System — a saving of $40,815.00 (63 cents out of each $1.00). On an equipment investment of $40,968.00, the system would pay for itself in one year. In 5 years it would save this company over $200,000.00!

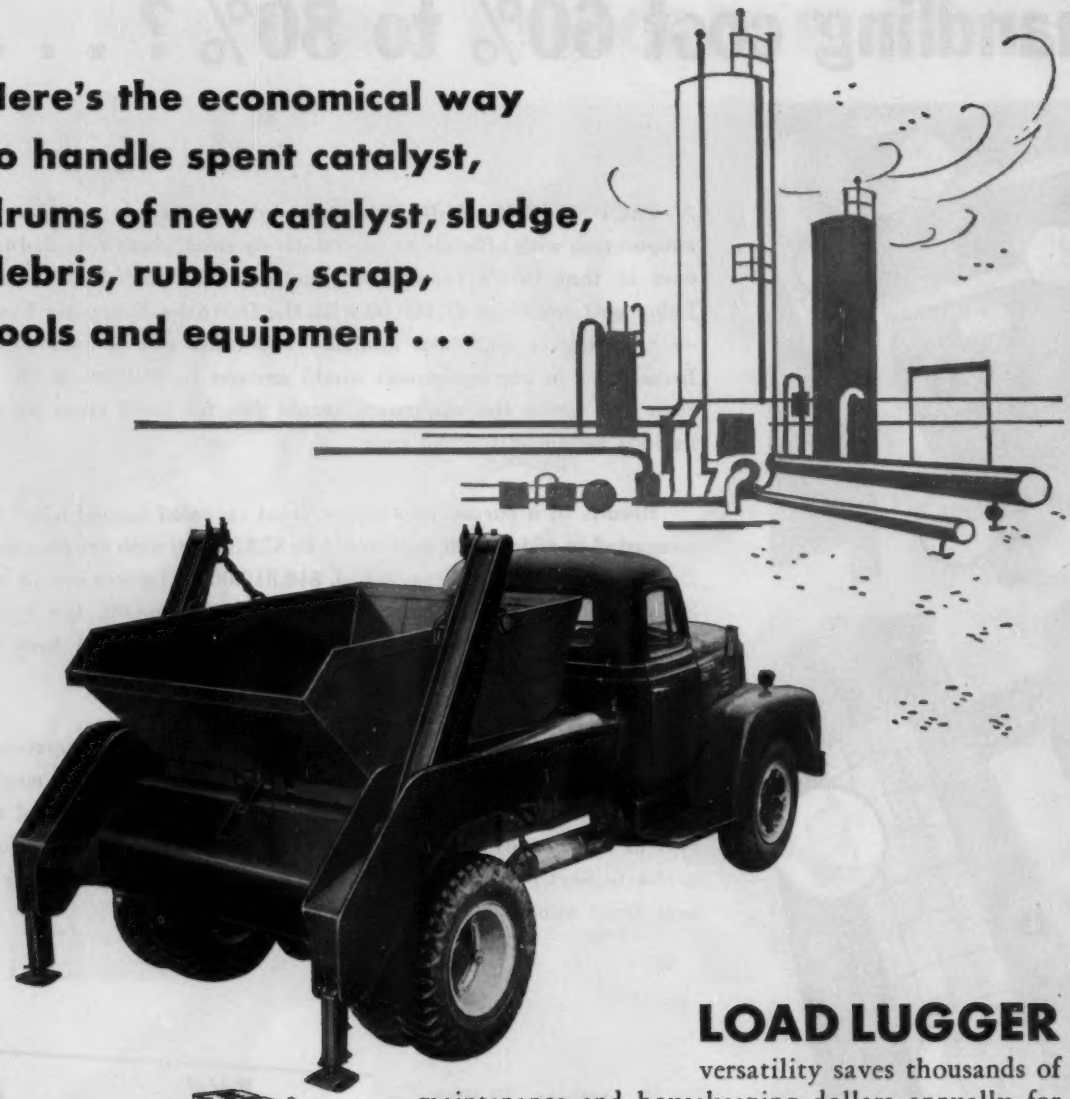
How much can this equipment save you? We recommend a fact-finding survey. No obligation, of course. It is the best way we have found to help you determine what can be expected of this system in your own particular operation. Or, perhaps you would prefer to first receive complete literature, free on request. May we hear from you? *Dempster Brothers, Inc.*

One Truck-Mounted
Dempster-Dumpster Handles Scores
of Containers... All Designs... All Sizes

DEMPSTER BROTHERS, 547 Dempster Building, Knoxville 17, Tennessee

For more data on advertised products, use Readers' Service Cards, last page.

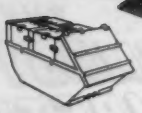
Here's the economical way to handle spent catalyst, drums of new catalyst, sludge, debris, rubbish, scrap, tools and equipment . . .



LOAD LUGGER

versatility saves thousands of maintenance and housekeeping dollars annually for refineries throughout the country. Disposing of combustible material, handling scrap, tools and equipment in turnaround operations, simplifying scrap disposal in maintenance shops, keeping refinery premises free of debris are a few of the ways Load Lugger reduces refinery maintenance costs.

Let us show you performance facts and figures and full details about The Load Lugger System—Load Lugger equipped truck + detachable Load Lugger containers. Write today.



LOAD LUGGER CONTAINERS

are available for handling solvents, liquids, gases. Practically any type of material can be moved efficiently with the Load Lugger system.

LOAD LUGGER

BW

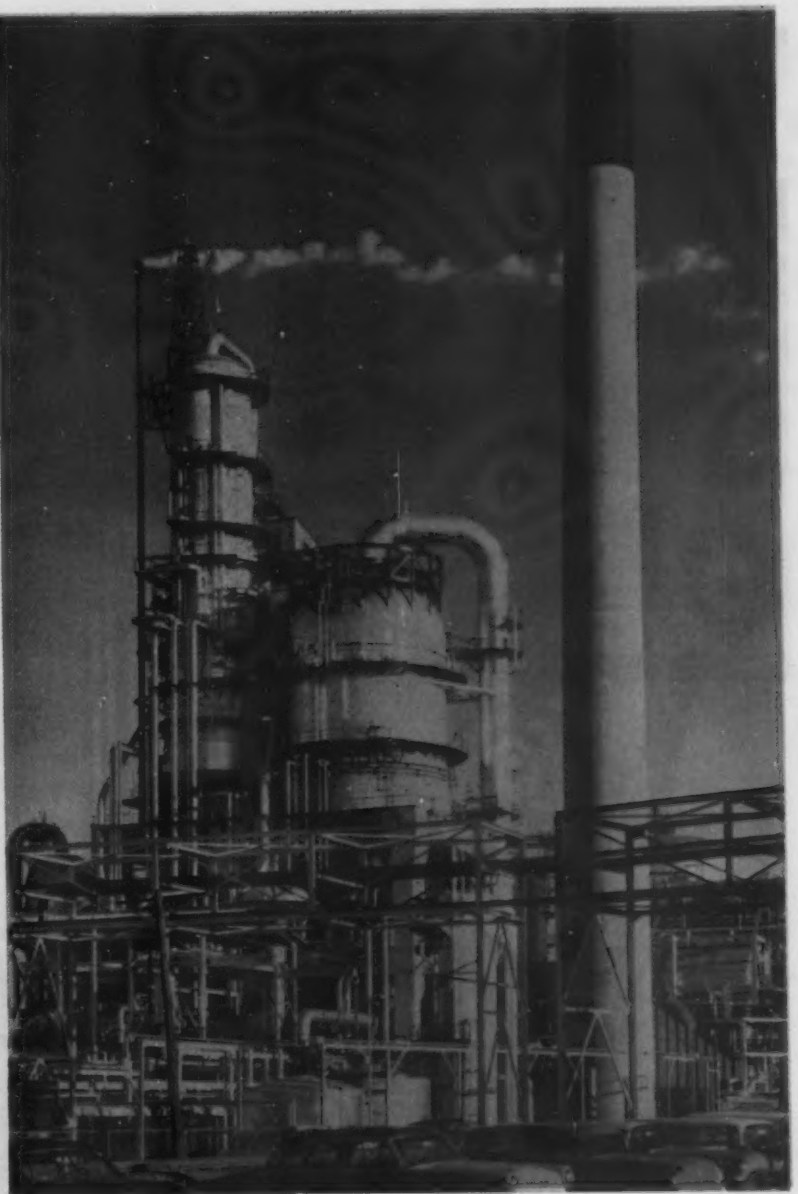
LOAD LUGGER, Ingersoll KALAMAZOO DIVISION
BORG-WARNER CORPORATION
1894 North Pitcher Street, Kalamazoo, Michigan, Telephone Fireside 5-3501
EXPORT SALES: BORG-WARNER INTERNATIONAL CORPORATION, CHICAGO

World's Largest FLUID COKER Lined with HI-STRENGTH F-303-S and I-R-C 20-G

The Mexico Refractories Company manufactures a custom-built Castable for most every refractory application in the Oil and Chemical fields — fields in which Mex-R-Co has specialized for years.

Typical Mex-R-Co products, the result of these years of experience in specialization, are the two Refractory Castable products used in lining this mammoth vessel — HI-STRENGTH F-303-S and I-R-C 20-G.

Yes, experience counts! But, Quality Raw Materials PLUS Controlled Manufacture PLUS Application Know-How are what makes the big difference in Mex-R-Co "Better Refractories" products.



World's largest fluid coking plant recently built at Tidewater Oil Company's Avon Flying-A Refinery at Associated, California.

Engineers-Constructors: Bechtel Corporation
Castable Installation: J. T. Thorpe & Son, Inc.
Licensed by Esso Research and Engineering Company. Process by C. F. Braun & Company.

PLACE YOUR REFRACTORIES NEEDS IN THE SURE HANDS OF EXPERIENCE

MEX-R-CO

Write for detailed information on Refractory Castables for the Oil and Chemical industries. Representatives in all territories—foreign and domestic.

120

MEXICO REFRACTORIES COMPANY
MEXICO, MISSOURI
NILES FIRE-BRICK DIV.—Niles, Ohio • NATIONAL REFRACTORIES DIV.—Philadelphia, Pa. • BIG SAVAGE REFRACTORIES DIV.—Frostburg, Md.
Canadian Affiliate: REFRACTORIES ENGINEERING & SUPPLIES, LTD.—Hamilton, Ontario, Canada

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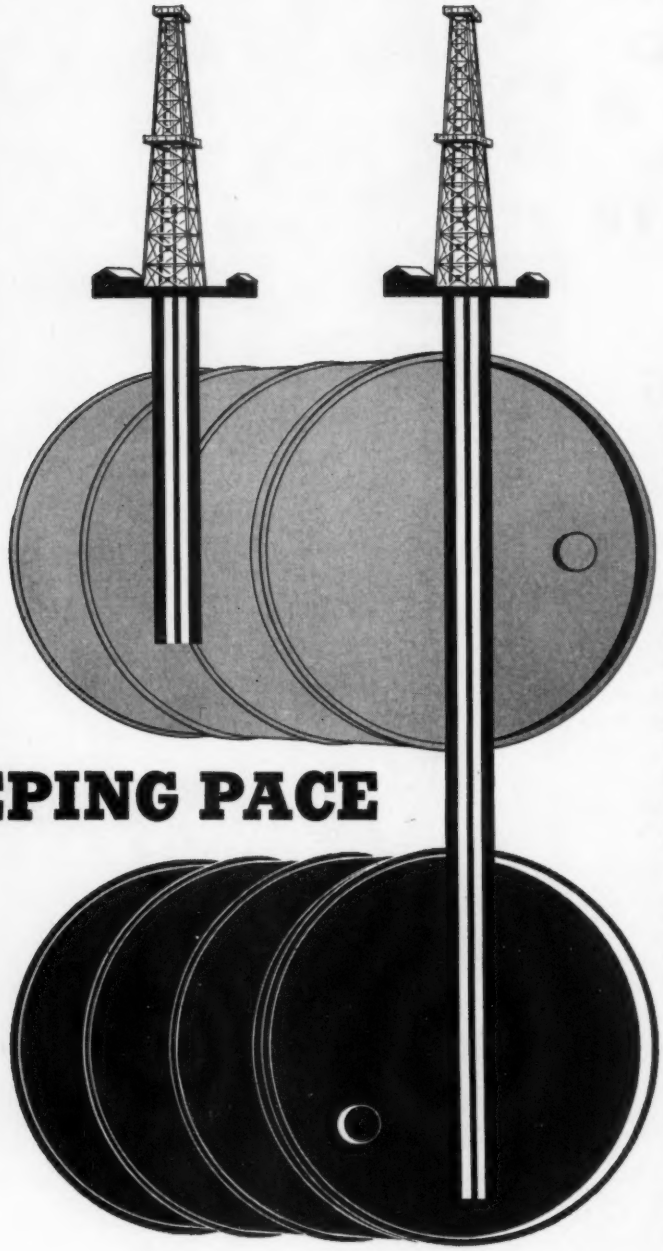


KEEPING PACE

Drills were chewing their way down for about 2000 feet in the search for oil in 1916. Today's drilling depth is more than double that.

The change in drilling that forty years has brought well symbolizes many advances in the petroleum and chemical industries. Engineers have dug more deeply into the secrets of nature, too . . . have designed plants and processes to wrest new products and services from petroleum, ores and elements.

We mentioned 1916 because that is the year Sun Ship was founded. It has long served the swift-growing needs of petroleum and chemical industries. Year by year, the engineering skill and facilities of the great Sun Ship plant have proven their ability to meet the demands for plant and equipment keyed to the swift pace of progress in these and other important fields. Sun Ship keeps pace with progress.

Sun

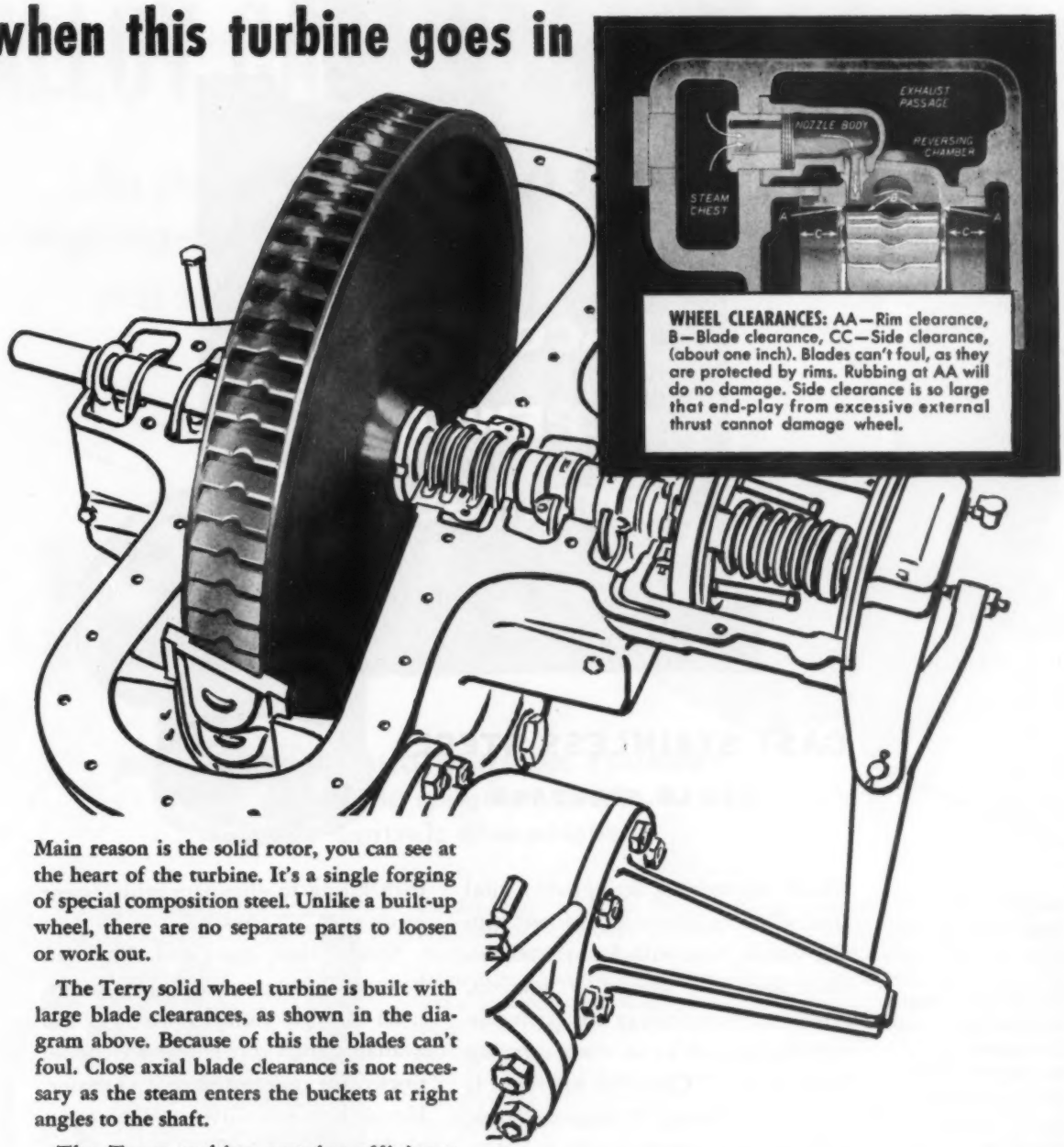
SHIPBUILDING & DRY DOCK COMPANY

SINCE 1916

ON THE DELAWARE • CHESTER, PA.

WHY TROUBLE GOES OUT

when this turbine goes in



WHEEL CLEARANCES: AA—Rim clearance, B—Blade clearance, CC—Side clearance, (about one inch). Blades can't foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.

Main reason is the solid rotor, you can see at the heart of the turbine. It's a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out.

The Terry solid wheel turbine is built with large blade clearances, as shown in the diagram above. Because of this the blades can't foul. Close axial blade clearance is not necessary as the steam enters the buckets at right angles to the shaft.

The Terry turbine sustains efficiency through the years. Reason: The power producing action of the steam takes place on the curved surfaces at the back of the buckets, so blade wear which might occur is of little consequence.

Bulletin S-116 tells more about these *"Work Horses of Industry."* Send for a copy today.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1202

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IMMEDIATE DELIVERY...

ESCO IPS SCREWED FITTINGS

CAST STAINLESS STEEL

150 LB. STANDARD

ESCO cast stainless fittings are a vital part of every corrosion resistant piping system. Cast with heavy wall sections and in a variety of analyses, *ESCO* screwed fittings are carried in warehouse stocks in sizes ranging from ⅛" to 4". Complete size range is available in 90 and 45 degree elbows, tees, crosses, unions, couplings, reducers, plugs, bushings and locknuts. Permanent alloy identification is cast in each fitting to eliminate replacement error.

Special sizes, types and alloys can be made to engineering specifications.

ESCO cast stainless fittings are available from convenient warehouse stocks. See your nearest *ESCO* dealer. He can help you solve your corrosion problems. Ask for *ESCO* Catalog No. 156 giving complete dimensional data.

ESCO

ELECTRIC STEEL FOUNDRY COMPANY

2164 N. W. 25TH AVE. • PORTLAND 10, OREGON
MFG. PLANTS AT PORTLAND, ORE. AND DANVILLE, ILL.
Offices in Most Principal Cities
ESCO INTERNATIONAL, NEW YORK, N. Y.
IN CANADA ESCO LIMITED

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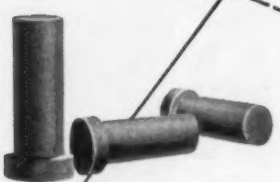
AIRCRAFT QUALITY

ALLOY CASTINGS

...for the special requirements of your industry



METALS PROCESSING DIVISION FOUNDRY handles wide range of sizes, closely controls dimensions

Precision testing methods provide close control of casting quality

Curtiss-Wright's Metals Processing Division today offers your industry precision castings of critical parts in a wide variety of sizes, and with closely controlled dimensions. For example, in the large casting shown, tolerance is ±.030 over 36″ diameter. From its modern, completely equipped foundry in Buffalo, the Division supplies heat, corrosion and abrasion resistant castings from a full range of special-property alloys, including ductile iron...by sand, centrifugal, ceramic or shell processes.

Precision alloying techniques, modern melting controls with spectrometer testing, X-ray control by experienced radiographers — all add up to castings with superior physical and mechanical properties . . . mean better and more dependable products for the critical needs of industry. Qualified design engineering assistance is a part of the comprehensive Metals Processing Division service. Write for details.

70 Grider Street

METALS PROCESSING DIVISION
CURTISS-WRIGHT
CORPORATION • BUFFALO, N. Y.

Metals Processing Division Branch Offices: New York • Houston • Los Angeles

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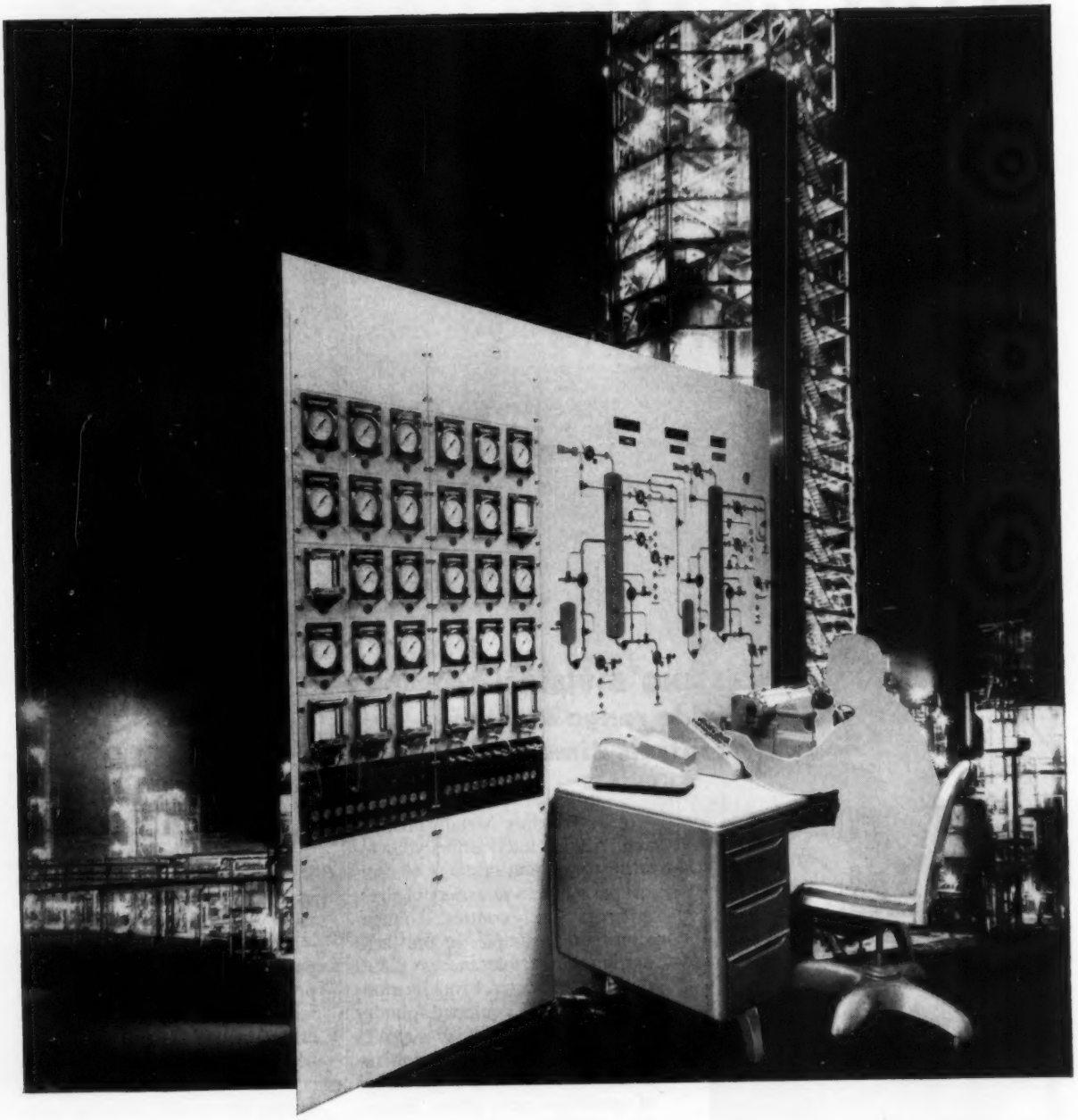
Are you ready for



Taylor Instruments

ADVANCED SYSTEMS ENGINEERING?

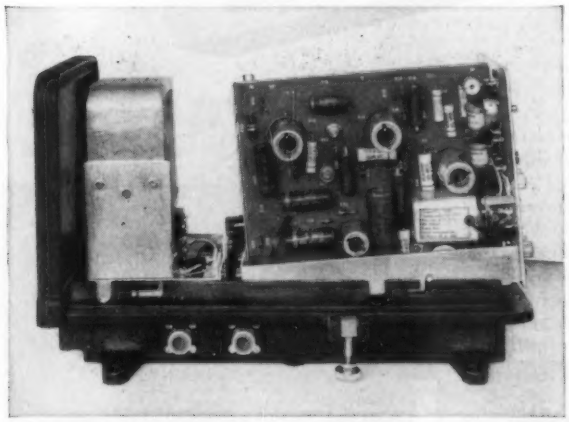
IF SO you will need more thorough evaluation of process variables through automatic process scanning and logging integrated with automatic control. You should look into the *Taylor Trans-Scan-Log* Control System. . .* it will pay real dividends.

The TSL* System provides the important link between process control and process evaluation. Not just scanning and logging, it is an evolutionary step interlocking scanning and logging with process control to put *complete* information in front of the operator. He can instantly visualize, evaluate and act upon any processing irregularity as it occurs.

The TSL System is extremely valuable for collecting data. It provides production, accounting and marketing departments with operating data as it is accumulated, either on log sheets, punch cards or tape. But its biggest dividends come from improved operating efficiency.

Because no instrument cut-outs are necessary, normal graphic panel space requirements are cut by 40% . . . and the flow chart can be readily changed to match any process rearrangement. With plug-in receivers and controllers mounted on a separate section of the panel, maximum process flexibility is achieved.

The TSL System is truly a boon to advanced systems engineering. We'd like to tell you more about it, and to demonstrate it in action. Your Taylor Field Engineer will be glad to make the necessary arrangements. Meanwhile write for **Bulletin 98268.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.



Taylor TRANSET* Potentiometer Transmitter—an electro-pneumatic instrument which converts an electrical signal to a 3-15 psi output. It is completely adaptable for the measurement of a wide variety of variables and for use with different electrical primary elements. Permits use of pneumatic controllers and receivers where conventional measuring circuits have not proved adequate.

New Taylor TRANSCOPE* Controller, the last word in pneumatic process control, is ideal for the TSL System. A miniature (6″ x 6″ x 4½″) controller new in principle and design, it has no equal in performance on applications where the span of measurement is very short. Exceptionally adaptable to changes in process requirements; simple to maintain; easy-to-understand unique motion balance principle of operation.

*Trade-Mark

VISION • INGENUITY • DEPENDABILITY

MEAN ACCURACY FIRST

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How to simplify control problems

Keep systems flexible, carry small inventory, cut maintenance cost with the **Bailey Building Block Method** of instrumentation and control.

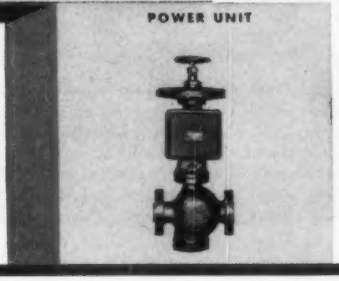
What is the Bailey Building Block Method? It's using standardized Bailey measuring, transmitting, and controlling components and combining them into any system you need. Components can be added as needed . . . removed and reused elsewhere . . . recombined into another system when the need changes. It's flexibility plus!

It's all based on the simple fact that a Bailey instrument or control component doesn't care if the measured variable is steam flow, tank level, or tower temperature, to pick just three examples. System components—transmitters, receivers, relays, selector stations, power units—are standardized for multi-purpose use.

A spare component can be used in any one of many systems. Gone are delays waiting for shipments of special parts. Gone are large inventories of spares and parts. Simplified is the training of men for maintenance.

There are many exclusive features and advantages of the individual components used in the Bailey Building Block Method. And there's much more to the Building Block story itself.

For further details, call our local district office or write us at Cleveland. Our engineers will be glad to prove how the Building Block approach will save you money and simplify your instrument and control problems.



G36-1

BAILEY BUILDING BLOCK METHOD

BAILEY METER COMPANY
1043 IVANHOE ROAD, CLEVELAND 10, OHIO
In Canada—Bailey Meter Company Limited, Montreal

RESULTS IN: FLEXIBILITY, SIMPLICITY, ECONOMY

BAILEY METER

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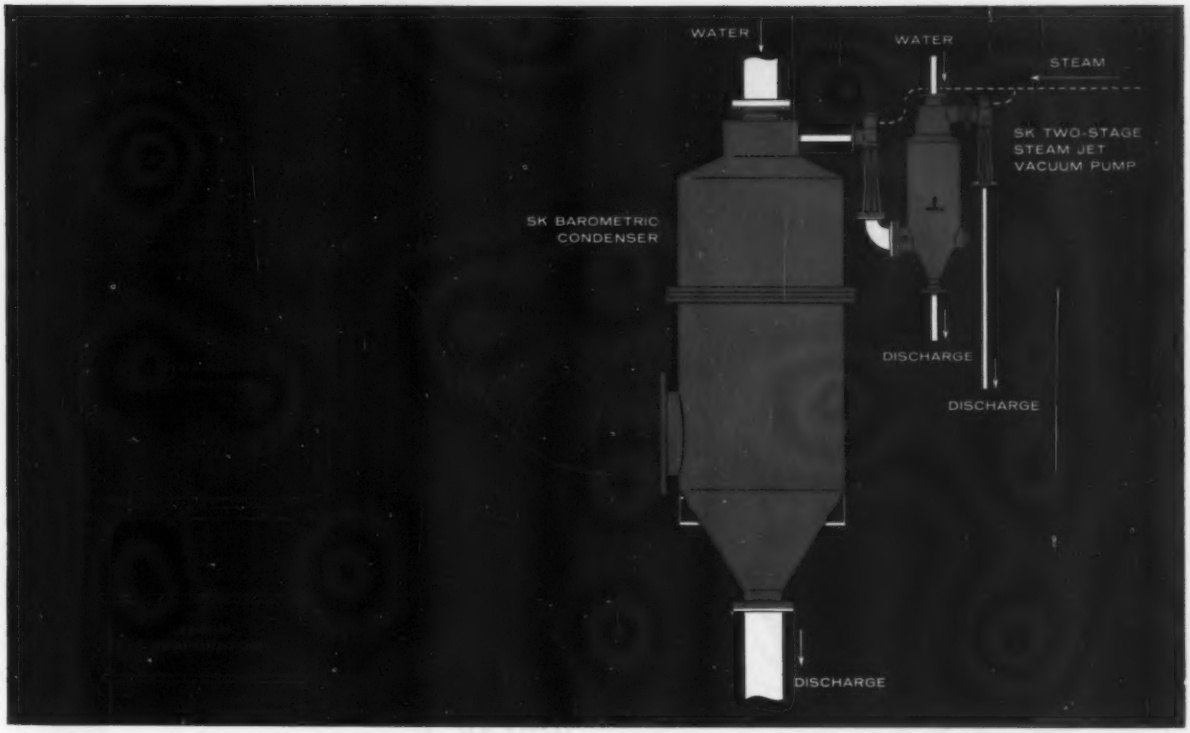
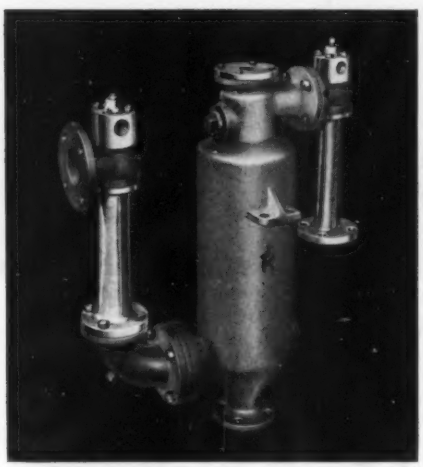


SK VACUUM PUMP HELPS MANUFACTURER

make better product at lower cost

SK Two-Stage Condensing Steam Jet Vacuum Pump



SK Steam Jet Vacuum Pumps utilize the kinetic energy of pressure steam to entrain and remove gases and vapors. Because they offer outstanding advantages—simple design with no moving parts, low initial cost, and long life expectancy with little supervision or maintenance—they have opened a whole new field for application in the petro-chemical and other industries.

A typical example is shown above. This is part of a refined, improved process developed by a large southern manufacturer. The two-stage steam jet vacuum pump illustrated consists of two exhausters with a barometric counter-current intercondenser. It is used to maintain an absolute pressure of approximately 1 inch of mercury on a system consisting of a single effect evaporator together with an entrainment eliminator and an SK barometric counter-current pre-condenser. The condensable vapors are removed in the pre-condenser and the two-stage vacuum pump handles the non-condensable gases plus moisture of saturation. Two single-stage exhausters are used on a section of the process not shown to maintain vacuum on a dearator and a holding tank.

The improved process is outstanding in increased efficiency and control of product. And the SK Vacuum Pump has helped make it so.

Many sizes of Vacuum Pumps are carried in stock by SK and are available for immediate delivery. For material on Vacuum Pumps and for information on other types of SK Jet Apparatus, write for a copy of Bulletin J-1.

JET APPARATUS: Ask for Condensed Bulletin J-1.
ROTAMETERS & FLOW INDICATORS: Ask for Condensed Bulletin 18-RA.
VALVES: Ask for Condensed Bulletin V-1.
HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin HT-1.
GEAR PUMPS: Ask for Bulletin 17-A.

Schutte and Koerting
COMPANY
MANUFACTURING ENGINEERS
2257 State Road, Cornwells Heights, Bucks County, Pa.

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Memo: to all process engineers—

Why Tolerate Liquid Carry-Over?

...when METEX Hi-Thruput Mist Eliminators can deliver 100% efficiency!

● Whether it's on a vertical tube evaporator, a packed column, knock-out drum or a vacuum pipe still, there's no necessity, *today*, to permit poor liquid-vapor separation to pull product quality and profits down. With Metex, you have a unit that's *different*. Hundreds of thousands of openings and wire surfaces, so combined as to baffle uprising gas-liquid streams in multiples of thousands of physical separating contacts, can and *do effect complete gas-liquid-contaminant separation.*

No other unit delivers more efficiency, offers longer life or less maintenance. Used and specified by hundreds of process engineers, Metex Hi-Thruput Mist Eliminators are the standard of excellence wherever efficient entrainment separation is important to good production and profits.

• Write for Bulletin ME-6

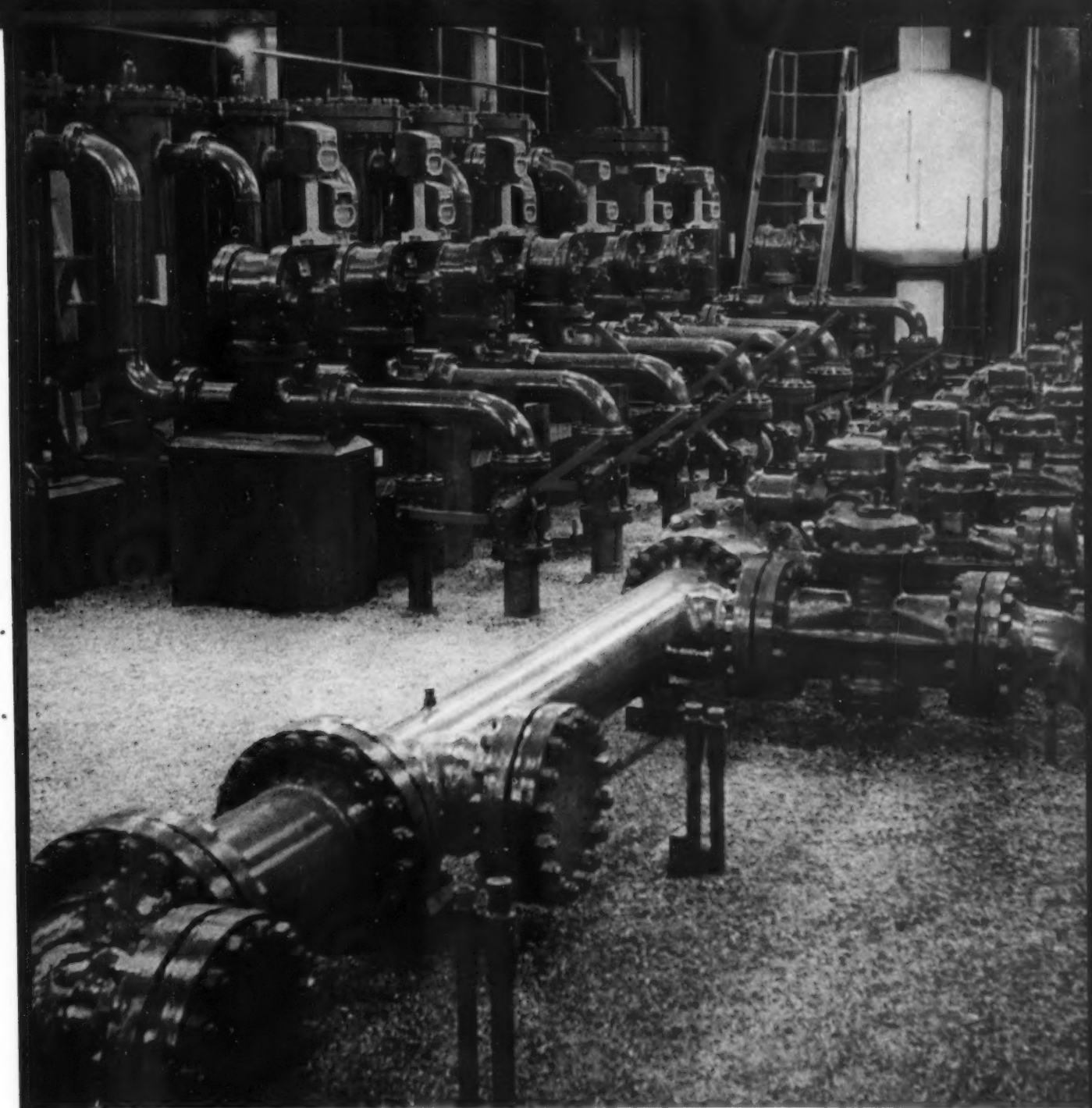
METEX QUALITY PRODUCTS

• metal textile corporation

roselle, new jersey

Representatives in principal cities throughout the world.

7-072



COMPACT DESIGN SAVES MONEY when you specify Rockwell-Nordstrom valves for tight manifolds like at the pipeline station above. (Rockwell Rotocycle meters are also shown.) Most Rockwell-Nordstrom valves take little more area than the diameter of the flanges—there are no bulky rising stems or cumbersome bonnet cavities. And less bulk means less weight too; that's another cost cutting bonus you gain for intricate piping arrangements in modern process plants.

You'll also save product loss and contamination because Rockwell-Nordstrom valves are lubricant sealed to be truly leakproof and to shut-off positively. From every standpoint, Rockwell-Nordstrom valves cost less to use and perform better. And they cost no more to buy, often less, than ordinary valves. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Available at leading suppliers . . . everywhere.

ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed For Positive Shut-Off

SENTINELS . . . These Rockwell-Nordstrom valves stand always ready for fast, easy operation. No matter how long a Rockwell-Nordstrom valve has been in open or closed position, *operation is instant.* Why? Pressurized lubricant in the exclusive Sealdport* system acts as an hydraulic jack to keep the plug free for smooth, easy quarter-turn operation and the same pressurized lubricant forms a lasting, *double seal* against leakage of lightest gases or heaviest slurries.

Where your valves must be sentinels against trouble . . . year after year . . . specify Rockwell-Nordstrom valves. They cost no more to buy, often less, than ordinary valves. Their dependability has been proved through forty years of exceptional performance in every industry. Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Registered trade mark Rockwell Manufacturing Company.

Available at leading suppliers . . . everywhere.

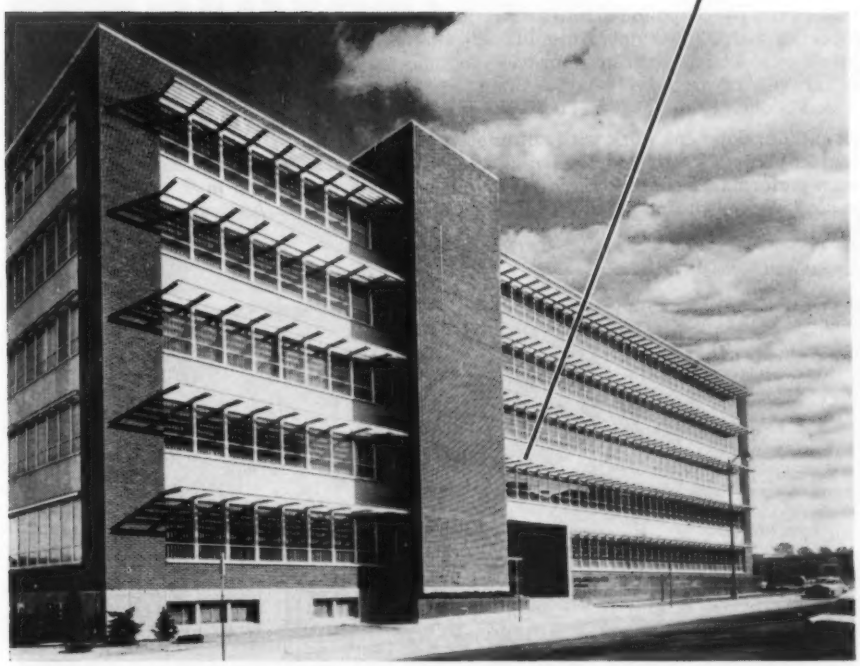
ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed for Positive Shut-Off

OPPORTUNITIES IN ENGINEERING

DENVER

For qualified engineers who would like to live in Denver and build a career



OUR CENTRAL ENGINEERING OFFICE

PROJECT – PROCESS ENGINEERS, DESIGNERS, DRAFTSMEN Experienced in Smelter & Mill Layout, Process Piping, Materials Handling, Structural Design, Electrical Design.

- Stearns-Roger is one of the largest and most progressive engineering and construction firms in the west. Current turnkey projects include: Smelters, Cement Plants, Concentrators, Gasoline Plants, Oil Refineries, Potash Plants, Rare Metal Mills, Chemical Plants and Power Plants.
- Ideal working conditions, liberal company benefits, and good salaries.
- Denver is internationally famous as a vacation spot. Ideal climate, over 300 days of sunshine, only 20 miles to the Rockies — trout fishing, hunting, skiing.

Address Director of Personnel

Stearns-Roger

P. O. Box 5370 Terminal Annex
660 Bannock St., Denver 17, Colo.

ESTABLISHED 1885

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you can meet any lubrication specification if you

BLEND WITH ENJAY PARATONE®

(VISCOSITY-INDEX IMPROVERS)

Base stocks blended with Enjay Paratone can be compounded into lubricants combining cold-weather quick starting properties with high temperature, low consumption characteristics. These lubricants are *all-season* oils, featuring improved gas mileage. More and more refiners and blenders are relying exclusively on Paratone to produce the high "VI" required in these all-season oils.

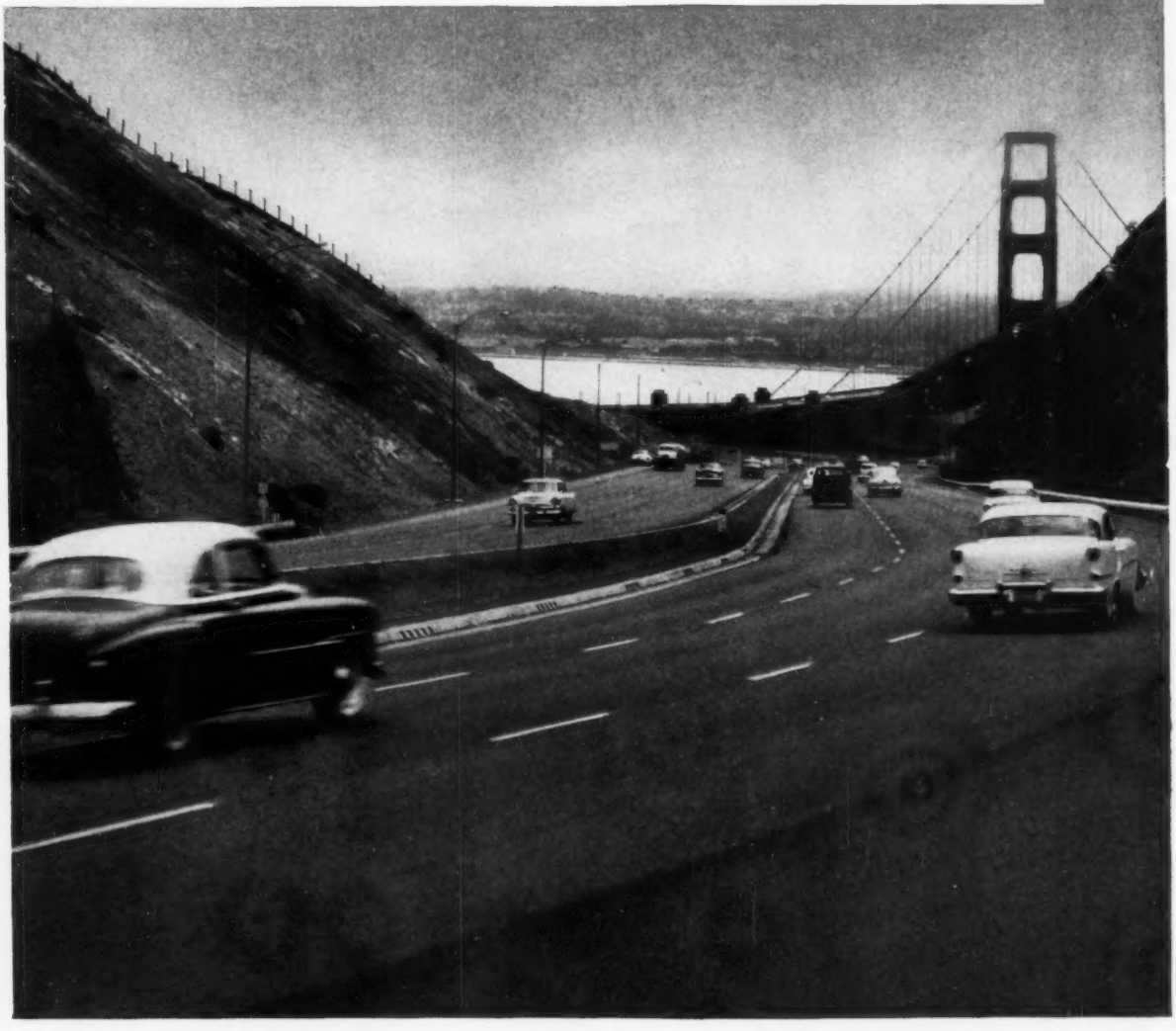
Through years of intensive research and development work with automotive manufacturers, Enjay has developed the only *complete line* of high quality additives (Paramins®) that can assure *maximum* performance characteristics. Why not let this experience and know-how work for *you*? Write, wire or phone the Enjay Company.

ENJAY

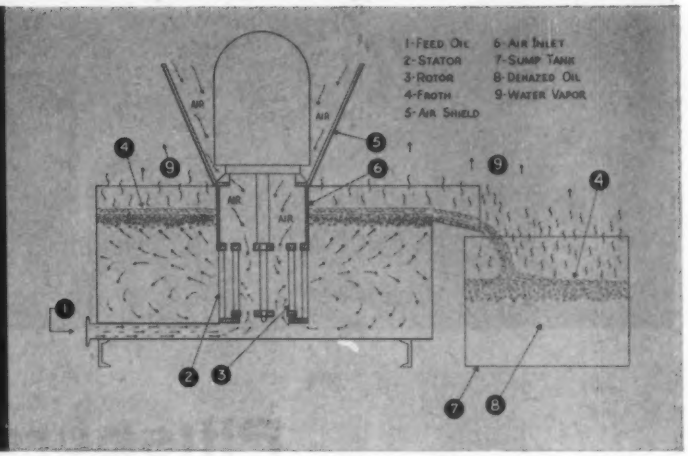
Pioneer in Petrochemicals

ENJAY COMPANY, INC., 15 WEST 51st ST., NEW YORK 19, N. Y.

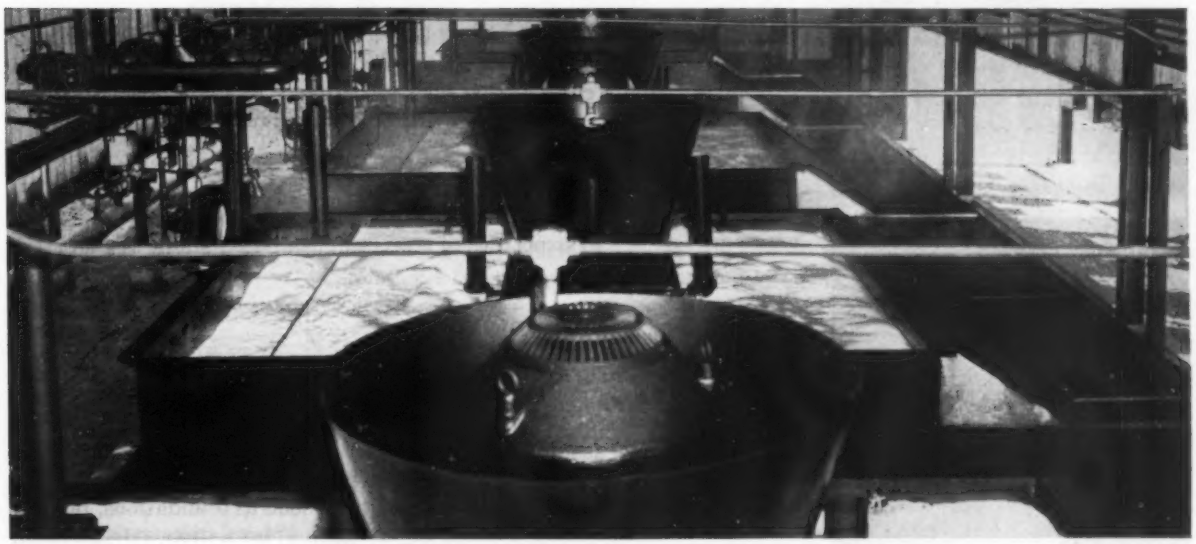
Akron • Boston • Chicago • Los Angeles • New Orleans • Tulsa



HENDRICK HYDRO-DEHAZER



removes haze from refinery oils in a hurry!



Here's a process that has been operating with a great deal of economy in several major refineries: The Hydro Dehazer's huge rotor mixes moisture-laden oil with free air until the moisture is absorbed by the air and discharged to atmosphere. The entire cycle achieves optimum efficiency without the use of compressed air, high heat, chemicals or other additives. Capacities range to 450 bph for No. 2 fuel oil at an inlet temperature of 130° F. with a haze point of 70° depending on the consistency of the charge. For details or a pilot model demonstration mail coupon today!

Hendrick
MANUFACTURING COMPANY
36 Dundaff Street, Carbondale, Pennsylvania
Sales Offices in Principal Cities

See our catalog in Sweet's

Perforated Metal • Perforated Metal Screens • Wedge Slot and Wedge Wire • Architectural Grilles
Mitco Open Steel Flooring • Shur-Site Treads • Armagrids • Hendrick Hydro Dehazer

HENDRICK MANUFACTURING COMPANY
36 Dundaff Street, Carbondale, Pennsylvania

Gentlemen:

I am interested in learning more about the new Hendrick Hydro Dehazer.

☐ Please send technical data.

☐ Please arrange demonstration of the Dehazer Pilot Model.

Name_____ Title_____

Company_____

Street_____

City_____ Zone_____ State_____

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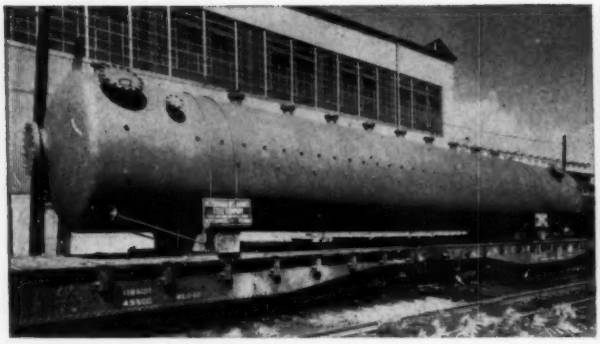
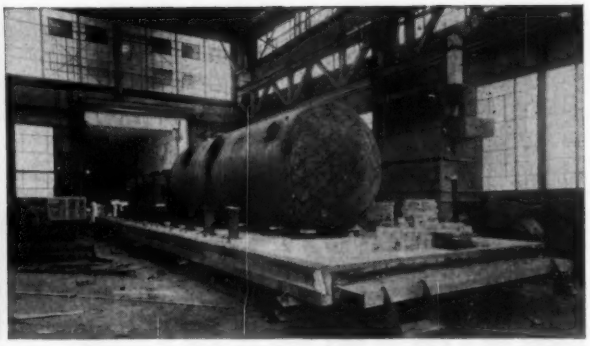
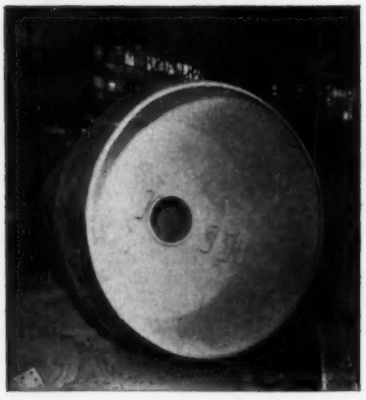




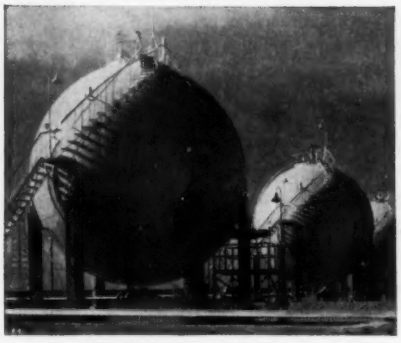
Pittsburgh-Des Moines

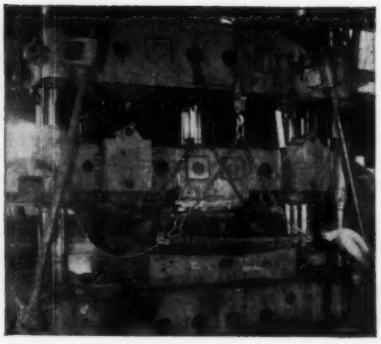
PRODUCTS Tanks, A.P.I. • Tanks, special • Tanks, insulated Tanks, lined • Elevated tanks • Pressure vessels • Spheres Plate construction • Large diameter piping • Structural steel Industrial type buildings • Steel bridges



MATERIALS Pittsburgh-Des Moines builds tanks, vessels and structures of steel, stainless steel, stainless clad steel, alloys and aluminum

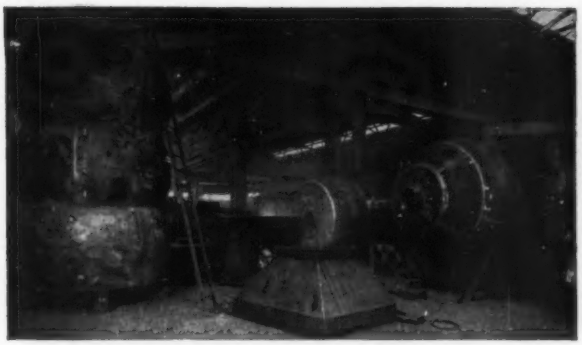
SERVICES Pittsburgh-Des Moines' complete service to the client includes *design*, to accomplish required objectives—*selection of material*, proper for service needs—*preparation of detailed drawings*—*fabrication*—and *delivery and erection or installation*. Included also are the design, procurement and installation of all associated items such as foundations, pumps, compressors, coolers, dryers, piping, insulation, refrigeration, controls, electric wiring, etc.

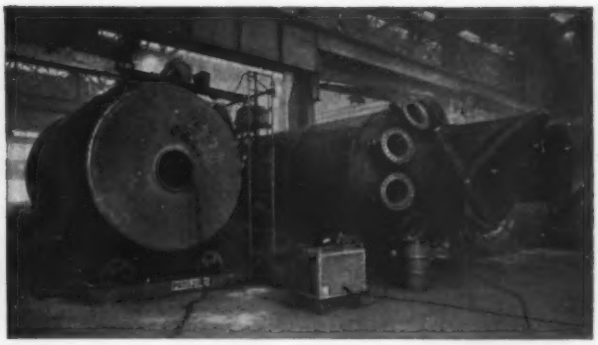




Plants at
PITTSBURGH DES MOINES
SANTA CLARA FRESNO
and CADIZ, SPAIN

PITTSBURGH-DES MOINES

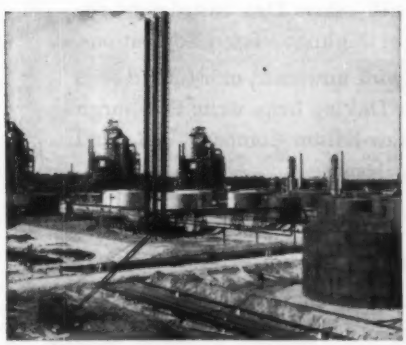




and the Petroleum Industry

SCOPE The range of PDM product manufacture includes tanks, vessels and plate construction of plates from ⅛″ to 4″ thick, shop-built vessels and structures, weighing up to 100 tons, and field-assembled vessels or structures of any size. Electric welding is employed in shop and field, together with riveting wherever necessary. Electric welds are radiographed as required, using X-ray and radioactive isotopes. Shop stress-relieving of vessels and structures is provided, and at Pittsburgh is installed one of the largest stress-relieving furnaces in the country—85 feet in length. Stress-relieving of field welds is employed where practicable. Steel grit blasting is used for cleaning of metal surfaces; the protective coating of metal surfaces is a well-researched PDM specialty. Also available is spray metallizing of steel, as required.

RESEARCH Pittsburgh-Des Moines for many years has maintained a full Chemical Storage Fellowship at Mellon Institute of Industrial Research, where basic studies are in continual progress on the storage of liquids and gases—particularly in pressure tanks, with insulation for hot or cold storage, and in the storage of corrosive liquids and liquids that turn to gases at atmospheric pressure. Answers to problems of design, the application of materials, or questions of procedures where information is not readily available, are developed from data of record or actual research and testing with the exceptional facilities provided.

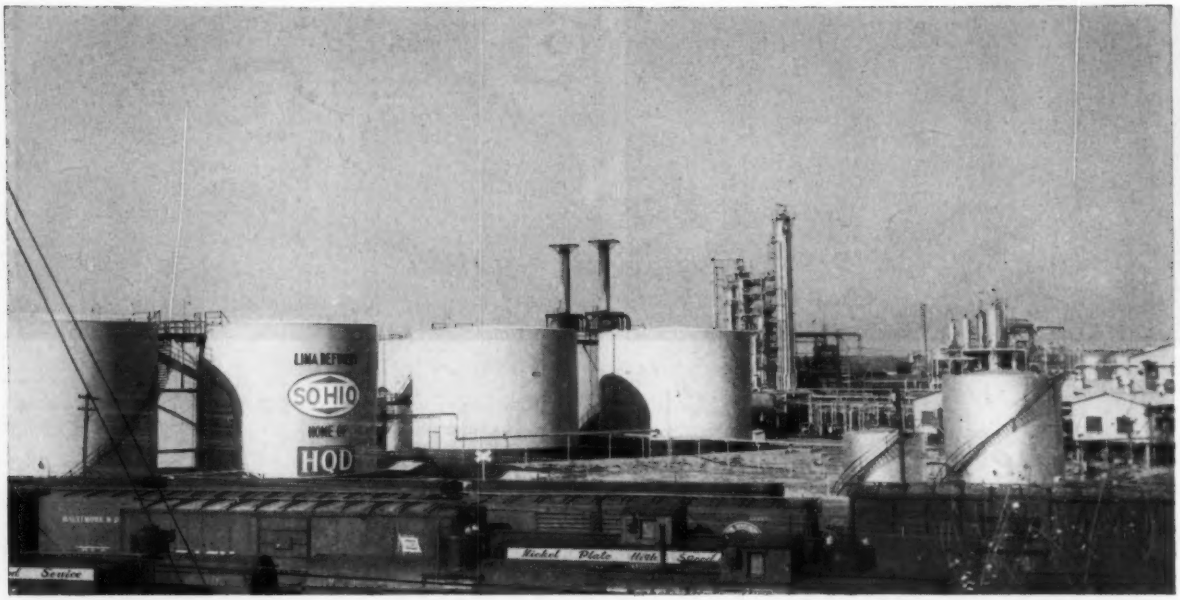


STEEL COMPANY PDM ENGINEERS · FABRICATORS · CONTRACTORS

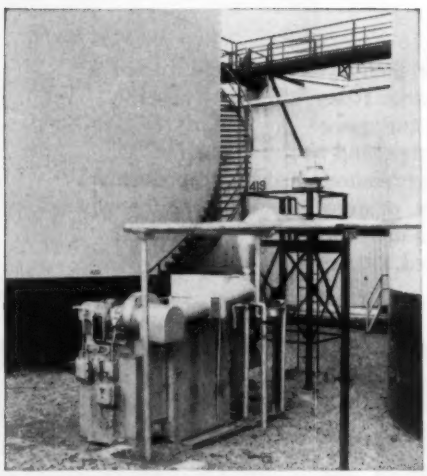
Sales Offices at

PITTSBURGH (25), 3482 Neville Island • **NEWARK** (2), 263 Industrial Office Bldg. • **CHICAGO** (3), 1286 First National Bank Bldg. • **EL MONTE, CAL.**, P. O. Box 2068 • **DES MOINES** (8), 983 Tuttle Street • **DALLAS** (1), 1287 Praetorian Bldg. • **SEATTLE**, 590 Lane Street • **SANTA CLARA, CAL.**, 689 Alviso Road • **MADRID, SPAIN**, Diego DeLeon, 60

For more data on advertised products, use Readers' Service Cards, last page.



SOHIO safeguards fine lube oils with a blanket of DRY air



Several of these Type CHK Lectrodryers are spotted among the tanks they serve.*

FINE LUBRICATING OILS, like those produced here at the Sohio Lima Refinery, must be guarded against contamination by moisture. Sohio accomplishes this by maintaining a blanket of DRY air over the oil at all times, and by admitting DRY air to a tank as oil is drawn off.

Lectrodryers do this DRYing with very little attention. A valve is thrown manually or automatically, at regular periods, to put a column on DRYing and then on regeneration, a cycle that's repeated day after day, year after year.

Other Lectrodryers here at Lima are DRYing propane before it goes into storage, while still others DRY instrument air, helping assure dependability of this huge refinery's operations.

Whatever your problems with unwanted moisture, there's a Lectrodryer to solve it. For DRYing help, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 307 32nd Street, Pittsburgh 30, Pennsylvania.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.

Now! Enter against pressure safely... at any time!

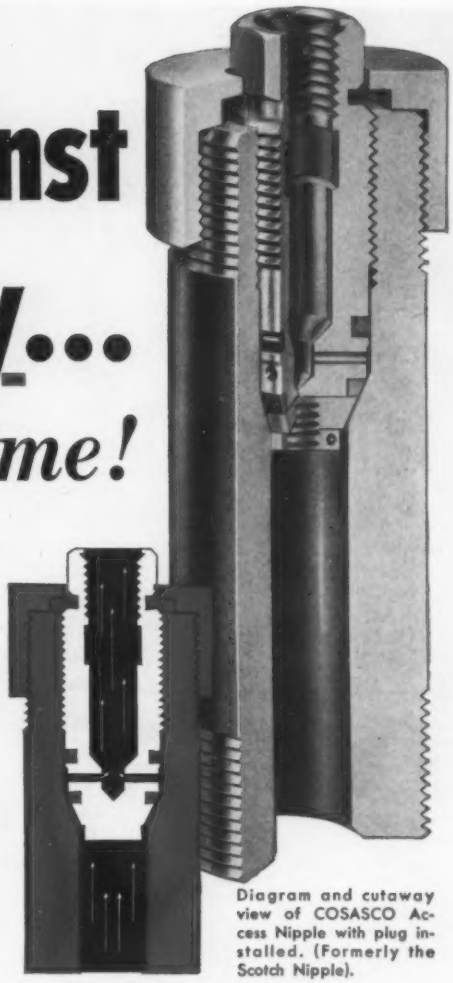


Diagram and cutaway view of COSASCO Access Nipple with plug installed. (Formerly the Scotch Nipple).

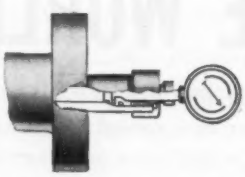
Wherever COSASCO Access Nipples are installed, you can go in against pressure with ease and perfect safety. At well heads, either the production string or annulus can be entered for instrument work. At refineries or along pipe lines, samplers, thermocouples, hydrogen probes, or coupons for corrosion studies can be inserted *without interfering with operations!* And expensive valves or other externals can be replaced or removed at will and without loss of pressure or product.

The COSASCO Access Nipple has a removable low carbon grade 303-304 stainless steel plug which, when turned down on the fine threads in the nipple outlet, effectively seals off the nipple at a tapered seat below. By-pass holes in the plug wall, between primary and secondary seals, provide communication through the plug to the exterior when the plug is backed out against a safety ring run down on the pipe threads on the nipple body.

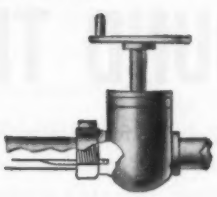
How entry is gained

With the COSASCO Retriever (Lubricator) and a full-opening valve mounted on the Access Nipple, COSASCO plugs, coupon holders or other units for inspection, testing, sampling, can be installed and removed at will regardless of pressure and without equipment shutdown. Details will be supplied promptly, on request.

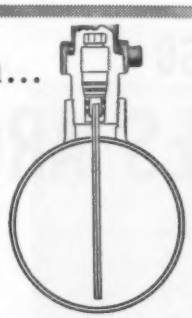
How **COSASCO** *Access* Nipples are used...



As a gauge valve, with plug installed. Gauge screws into end of plug.



As a valve re-installation nipple, with a thread and seat protector replacing the plug.



As a coupon holder for corrosion studies through taps in pipe lines and pressured vessels.

Protect equipment . . . Save product

What's your problem?

If it's an entry-against-pressure problem, COSASCO engineers invite you to submit details. Send blue prints and drawings to depict the problem, and the COSASCO solution will be supplied *without charge.* And you will be under no obligation whatever for this service.

COSASCO Access Nipples are applicable to any pressure or storage system, hydraulic or gaseous.

COSASCO

Division of Perfect Circle Corporation

3463 Ocean View Boulevard, Glendale 8, California

Address Mail to P.O. Box 277, LaCanada, California • Export Office: 617 S. Olive Street, Los Angeles 14, California

This 150-Foot Hose
STRETCHES AROUND THE WORLD

Refueling-in-air techniques such as these now make possible non-stop trips around the world. But no matter where the refueling takes place, the pipeline begins at the nation's refineries.

With experts predicting that by 1965 refined product sales will have increased 2½ times over 1946, the need for efficient refinery operations is obvious. Perhaps Polyrad—the filming amine inhibitor and detergent—can play a role in your operation.

Polyrad forms a molecular film that protects metal from attack and reduces down time caused by corrosive damage. Polyrad's detergent action keeps metal surfaces clean to maintain heat transfer and operation at unit capacity.

A Hercules trained representative will be glad to tell you how Polyrad can protect your refinery. Stocks are maintained at strategic points throughout the country and overseas.

Pine Chemicals Division, Naval Stores Department

HERCULES POWDER COMPANY
INCORPORATED

976 Market St., Wilmington 99, Del.

REFINERS RELY ON

POLYRAD®

FILMING AMINE INHIBITOR NA57-2

For more data on advertised products, use Readers' Service Cards, last page.

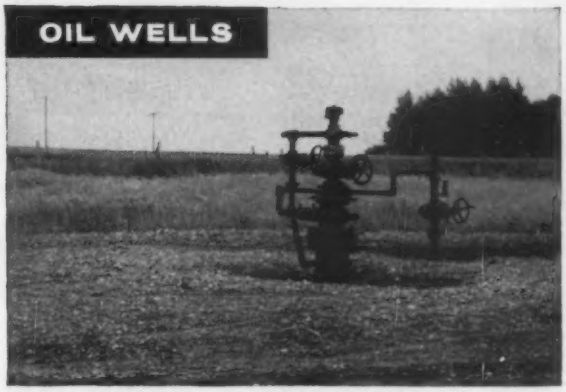
Keep areas weed-free . . . avoid fire hazards

Spray Du Pont TELVAR® WEED KILLERS just once for season-long weed control

You can eliminate weeds and grasses that create fire hazards and that make maintenance difficult and costly. Just one spray of Du Pont "Telvar" controls weeds for a season or longer. "Telvar" kills weeds through the roots, then remains in the soil to provide residual action long after the initial spray is applied. Low dosages save you cost, handling and storage space. "Telvar" weed killers are non-corrosive to equipment, non-volatile, low in toxicity to humans and animals. For low-cost, long-term control of weeds, include "Telvar" in your maintenance program.

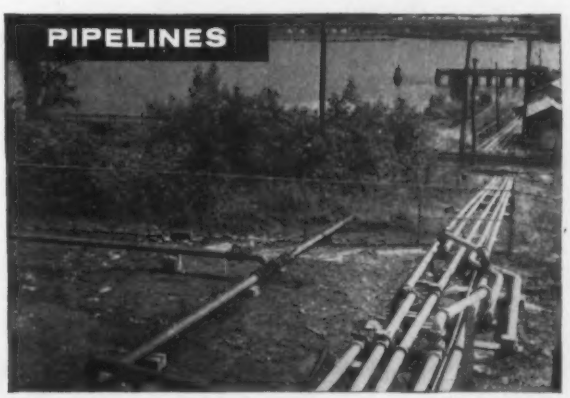
TELVAR®
Monuron and Diuron
WEED KILLERS

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY



Note the excellent control of weeds and grasses around this wellhead from just one application of "Telvar."

The treated area around this tank farm has remained weed-free for an entire season.



Along these pipelines, where maintenance is tough, one application of "Telvar" has kept the treated area weed-free for a year.

On all chemicals, follow label instructions and warnings carefully.

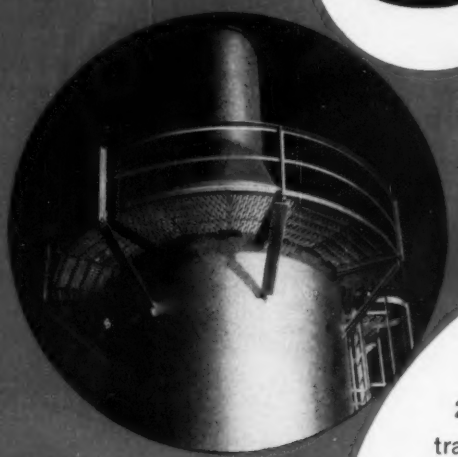
For more data on advertised products, use Readers' Service Cards, last page.

you can judge

the comparative values of furnace design as applied to operating requirements.

It's quite simple

there are 9 basic factors which must be evaluated to obtain the full comparison of values



1—Average radiant transfer rate. **2**—Maximum deviation from average radiant transfer rate. **3**—Average and maximum transfer rate in convection section. **4**—Maximum tube wall temperature, radiant or convection. **5**—Maximum efficiency with specified excess air. **6**—Controlled thermal recirculation of flue gases to provide even heat distribution throughout full length of each tube and equalized heat distribution around each tube. **7**—Overload and corresponding transfer load. **8**—Design to provide: structural column supports · Ladders · Platforms · Tube Removal facilities, etc. **9**—Degree of assembly; of the furnace structure and of the heating surface.

Whenever all these 9 specifications are applied to all the operating requirements, you can be sure PETROCHEM ISOFLOW FURNACES will be found most economically desirable.

No other furnace design can claim the recognition and acceptance achieved by PETROCHEM ISOFLOW FURNACES . . . starting with one installation in 1940, January '57 records more than 1650 ISOFLOW FURNACES in operation and under construction—a record that is incomparable just as all Petrochem Isoflow furnaces are more economically desirable by any comparison.

PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.

REPRESENTATIVES:

Rawson & Co., Houston • Wm. H. Mason Co., Tulsa • Lester Oberholtz, Los Angeles • Faville-Levally, Chicago • D. D. Foster, Pittsburgh • Turben, Philadelphia • Flagg, Brockett & Durgin, Boston • G. M. Wallace & Co., Denver & Salt Lake City

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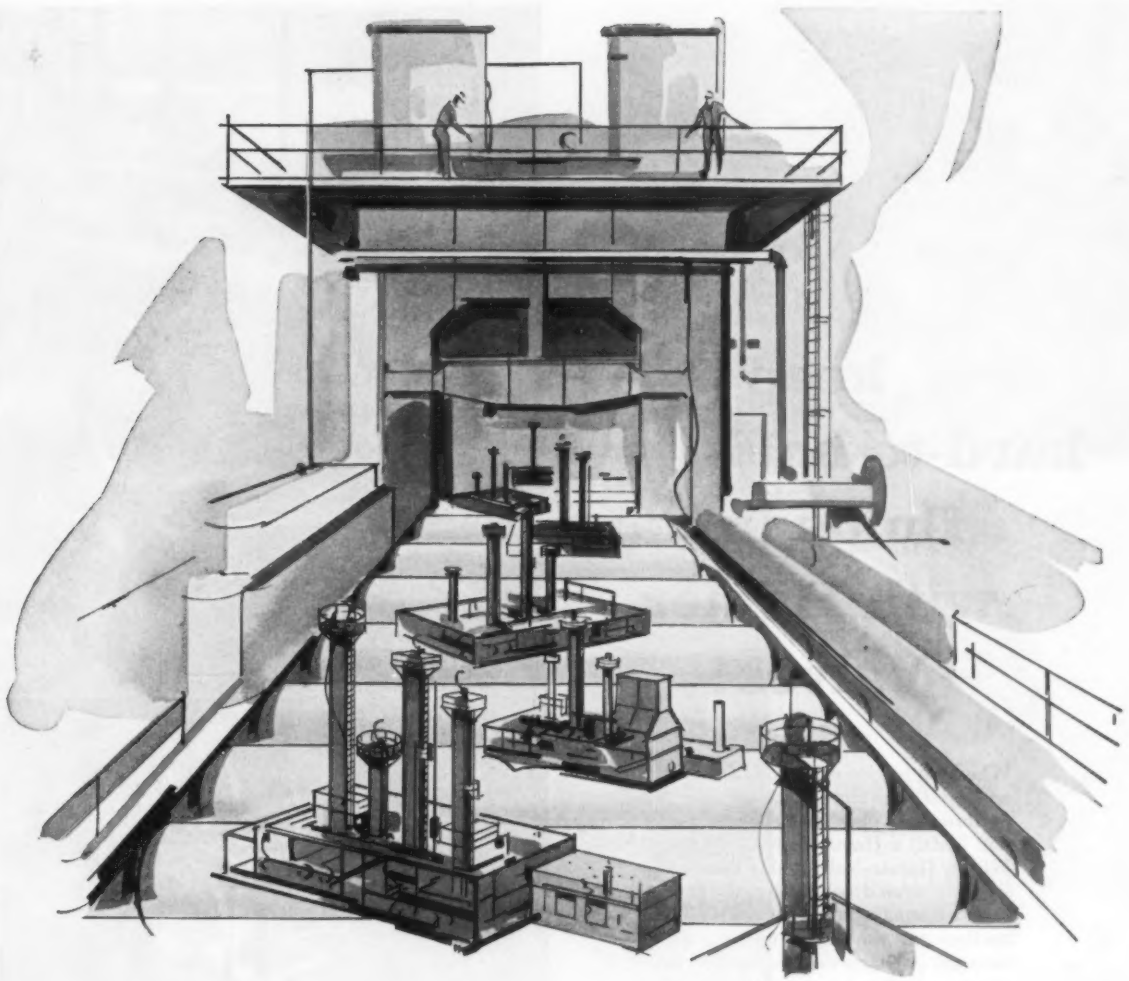
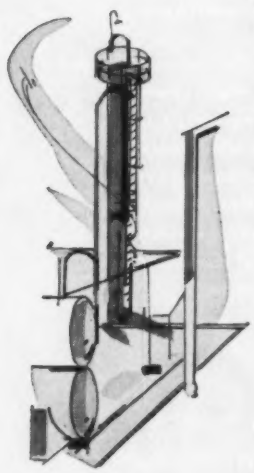


There's no production line for plant construction



There's nothing routine about this business of building petroleum refineries, chemical plants, and petrochemical plants. Every construction project is a different problem, a fresh challenge, an opportunity for new accomplishments. That's why we've assembled here at Procon an engineering and construction staff with the broad experience, the technical know-how, and the creative enthusiasm to meet and master any construction problem to your better-than-ordinary satisfaction. If you are in a building mood, Procon can help you!

PROCON *Incorporated*

1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS, U. S. A.

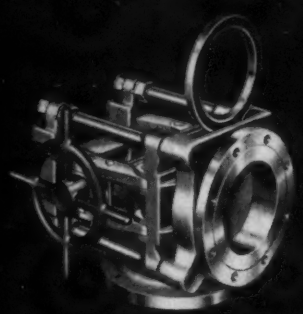
PROCON (CANADA) LIMITED, TORONTO 18, ONTARIO, CANADA
PROCON (GREAT BRITAIN) LIMITED, LONDON, W. C. 2, ENGLAND
PROCON INTERNATIONAL S. A., SANTIAGO DE CUBA

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

For more data on advertised products, use Readers' Service Cards, last page.

keep hard-to-hold fluids in hand with Hamer Valves!

When the service conditions are tough and a lot is riding on the valves performance, play it safe, specify and install a Hamer Valve.
Why a Hamer Valve? The reason is simply proven dependable performance ...a performance that has measured up time and time again under some of the most crucial service conditions to which any valve has ever been subjected.
Why are Hamer Valves so outstanding? We feel it is because of the extra measure of effort given to their design and manufacture. Hamer Valves are made slowly, carefully. Each valve part is individually inspected, each valve individually tested, each customer order analyzed to be sure the valves ordered are the right ones to do the job expected of it. Nothing is left to chance or guess.
To be sure, you will pay a little more for a Hamer Valve. But the unmatched performance, makes the additional cost well worth it for these fine Hamer Valves, truly a valve without equal.



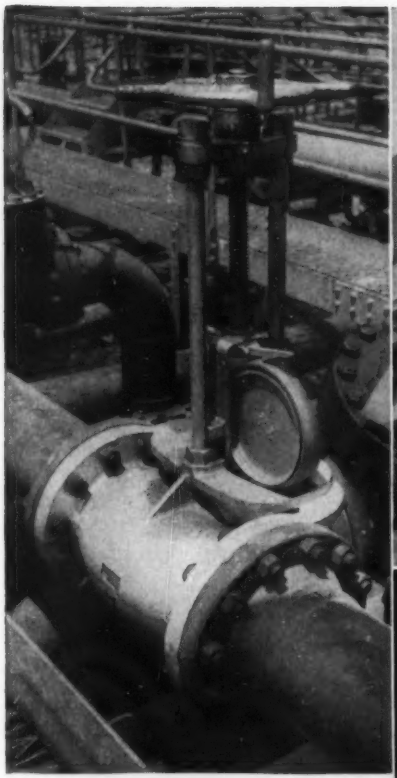
HAMER LINE BLIND VALVES

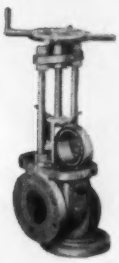
No contamination allowed here...

World-wide usage of the Hamer Line Blind for over two decades where absolute blanking of a line is required, is proof positive of this valve's effectiveness.
In addition, these remarkable valves will actually pay for themselves through savings gained by fast one man, one minute operation, elimination of complicated piping and costly downtime.

Hamer VALVES, Inc.

P.O. BOX 1851, 2919 GARDENIA AVE., LONG BEACH, CALIF.
REPRESENTATIVES THROUGHOUT THE WORLD





HAMER VISIBLE WEDGE

Foolproof line shut-off

A new high in safety, stability and simplicity of operation is incorporated in this outstanding rigid-type Visible Wedge Blind Valve. Precision metal-to-metal fit of the wedge and seats, plus dependable seal rings, provides a foolproof line shut-off that's both positive and permanent.

HAMER GATE VALVES

Leakproof Shutoff, Upstream, Downstream...

This remarkable valve combines a double sealing action through its metal to metal fit of the wedge plus two Teflon* seal rings. Actually one Hamer Gate Valve will do the job which formerly required two Gates for a double block and bleed arrangement. In addition, the wedge guide is precision machined to exacting tolerances. Eliminates chatter and mechanical wear caused by line pulsation and accurately centralizes the wedge between the seats.

*R. TM Dupont

HAMER PLUG VALVES

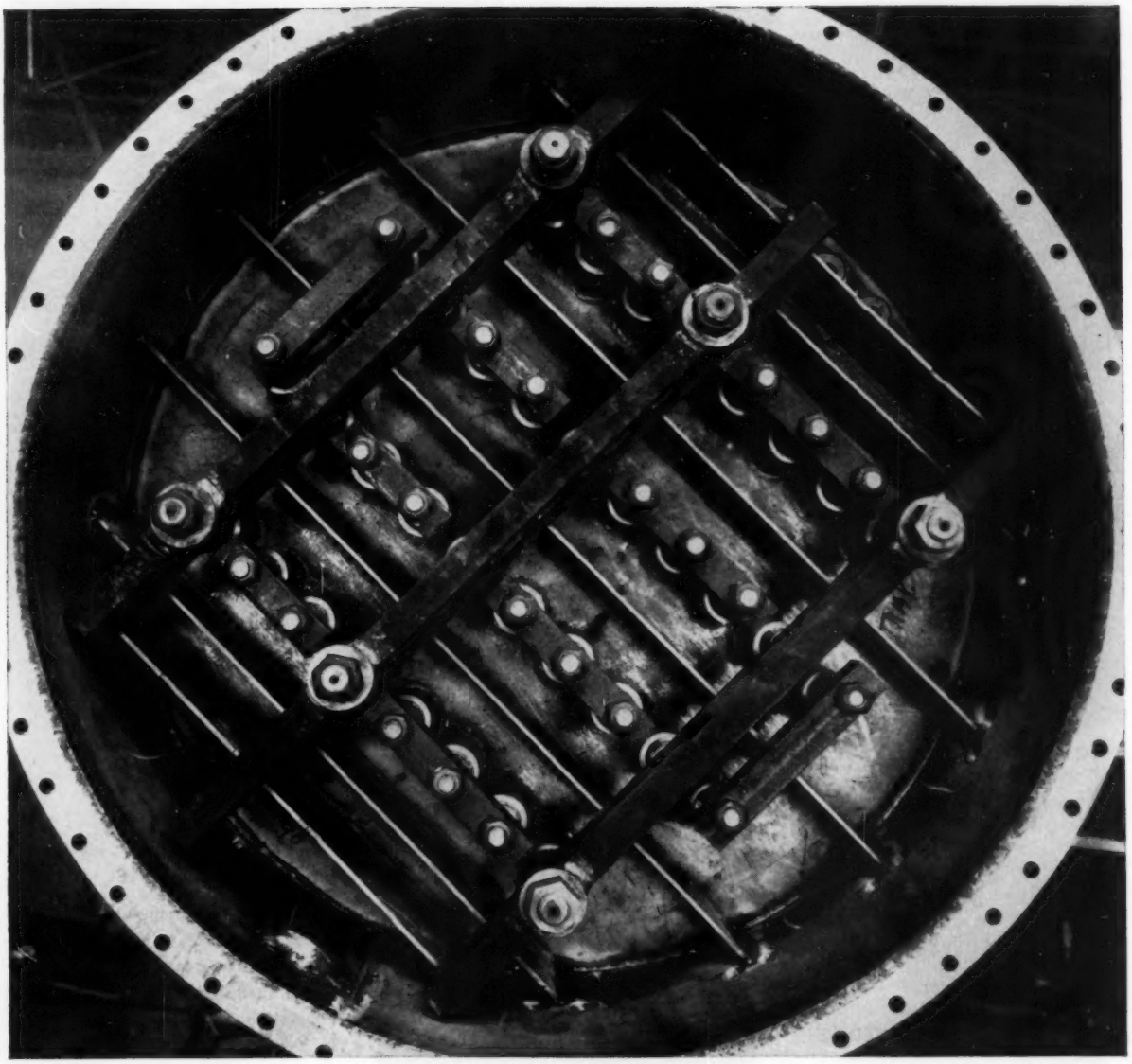
This Lift-Type Plug can't stick ever!

The plug adjusting nut, an exclusive feature on all Hamer Plug Valves permits the plug to be lifted slightly from its seat, making it easy to open or close the valve. A simple turn lowers the plug back into its seat and holds it there in perfect alignment. No matter what the service conditions, or lapse of time between operations, this outstanding Hamer feature assures POSITIVE E-Z Turn control of the plug at all times.

Send for Free Literature
Bulletins on all Hamer Valves are available and will be sent upon request

HAMER "POSITIVE ACTION" VALVES

For more data on advertised products, use Readers' Service Cards, last page.



THERE'S MORE TO AN EGG THAN THE SHELL . . .

What's inside the shell really counts most. Take this section of a Type 347 stainless steel tower. The complex interior design required exacting craftsmanship—no more so, however, than is customarily applied to every Graver project. Graver's alloy fabricating skills and experience cover a wide range of work from the simplest vessels to mammoth field erected towers and tanks. Whether your project calls for stainless steel, stainless-clad, nickel-clad or other miracle metals, Graver craftsmanship assures rigid conformity to specifications.

ALLOY DIVISION

1857-1957 GRAVER®

A CENTURY OF CRAFTSMANSHIP IN STEELS AND ALLOYS

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA • NEW YORK • PHILADELPHIA • EDGE MOOR, DELAWARE
PITTSBURGH • DETROIT • CHICAGO • TULSA • SAND SPRINGS, OKLAHOMA
HOUSTON • LOS ANGELES • FONTANA, CALIFORNIA • SAN FRANCISCO

For more data on advertised products, use Readers' Service Cards, last page.

Refinery Insulation

All CAPOSITE moulded insulation materials are made of Amosite asbestos. The photograph clearly demonstrates the immense volume which is obtained when the natural Amosite is fiberised—the sign of high efficiency as an insulating medium.

CAPOSITE is supremely well suited to the thermal insulation of oil refineries. With a limiting temperature of 1000°F., high thermal efficiency and great structural strength and resilience, CAPOSITE has gained for itself a unique position among thermal insulation materials used by the Oil Industry.

CAPOSITE MOULDED ASBESTOS FIBRE PIPE INSULATION

EFFICIENCY DATA SHEET—PIPE SIZES 6" to 10" BORE.

HOT FACE TEMPERATURE °F.			400°F			600°F			800°F		
THERMAL CONDUCTIVITY K=B.Th.U. in./sq. ft./hr./in./°F.			0.43			0.47			0.53		
MEAN TEMPERATURE °F.			250			350			450		
Nominal Pipe Size	O.D. pipe	Thickness of Insulation	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.	Heat Loss B.Th.U. sq. ft. hr.	Effic. %	Surface Temp. °F.
6"	6⅝"	1"	135	87·7	126	233	90·6	167	354	92·5	218
		1½"	102	90·8	107	177	92·9	135	270	94·3	171
		2"	83·6	92·4	97	145	94·1	118	223	95·3	145
		2½"	71·8	93·5	91	125	95·0	107	192	96·0	128
		3"	63·5	94·2	86	110	95·5	100	170	96·4	117
		3½"	57·3	94·8	83	100	96·0	95	154	96·7	109
		4"	52·6	95·2	81	91·7	96·3	91	142	97·0	103
8"	8⅝"	1"	130	88·0	127	225	90·8	169	341	92·7	222
		1½"	97·7	91·0	108	169	93·1	137	258	94·5	174
		2"	79·2	92·7	98	138	94·4	120	211	95·5	148
		2½"	67·4	93·8	92	117	95·2	109	180	96·1	131
		3"	59·2	94·6	87	103	95·8	102	159	96·6	120
		3½"	53·2	95·1	84	92·7	96·2	96	143	96·9	111
		4"	48·5	95·6	82	84·6	96·5	92	131	97·2	105

These figures are compiled from results of official tests by THE NATIONAL PHYSICAL LABORATORY, TEDDINGTON, computed in accordance with formulae shown in BRITISH STANDARD SPECIFICATION appendices.

Please write for full technical details

THE CAPE ASBESTOS COMPANY LIMITED

114 & 116 Park Street, London, W.1.

Cables: Incorrupt, London.

CAPOSITE REGD

Amosite Asbestos Blocks and Pipe Sections

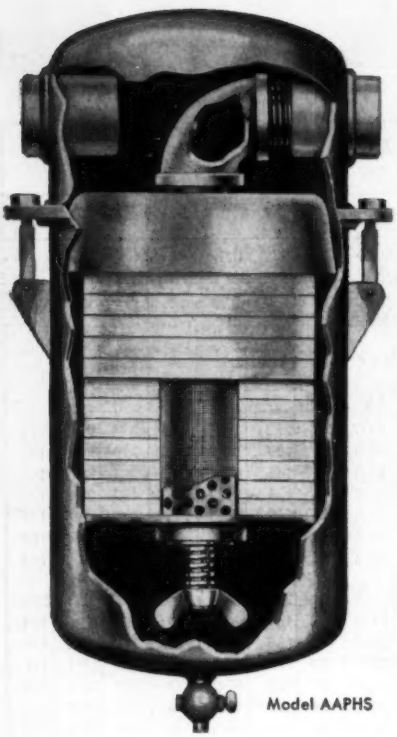
Enquiries in CANADA to: Cape Asbestos (Canada) Ltd., 200 Bloor Street East, Toronto, Ont.
U.S.A.: The North American Asbestos Corporation, Board of Trade Building, Chicago 4, Illinois.

SOUTH AFRICA: Cape Asbestos South Africa (Pty.) Ltd., P. O. Box 2533, Johannesburg; ITALY: Capamianto S.P.A., via Sant' Antonino 57, Turin. FRANCE: Isolamiante S.A. 37 Avenue Franklin D. Roosevelt, Paris 8e.

CAPE

does the WEATHER get in your AIR LINES?

you need STAYNEW ABSORPTION FILTERS

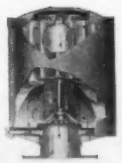


Model AAPHS

At this time of year—when the humidity is high—your compressed air lines carry lots of water . . . water that can rust and clog your equipment, ruin your work, or shut down your boilers.

That's why you need Staynew Absorption Filters in your lines. They remove every last trace of oil and moisture. In thousands of installations throughout the country Staynew Absorption Filters are protecting equipment and preventing process interruption . . . in most cases they are positively essential.

Write for Bulletin 200 which contains complete engineering data and illustrated material on Staynew Pipe Line Filters, including Model AAPHS Absorption Filter. Dollinger Corporation, Dept. 47, Centre Park, Rochester 3, N.Y.



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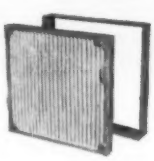

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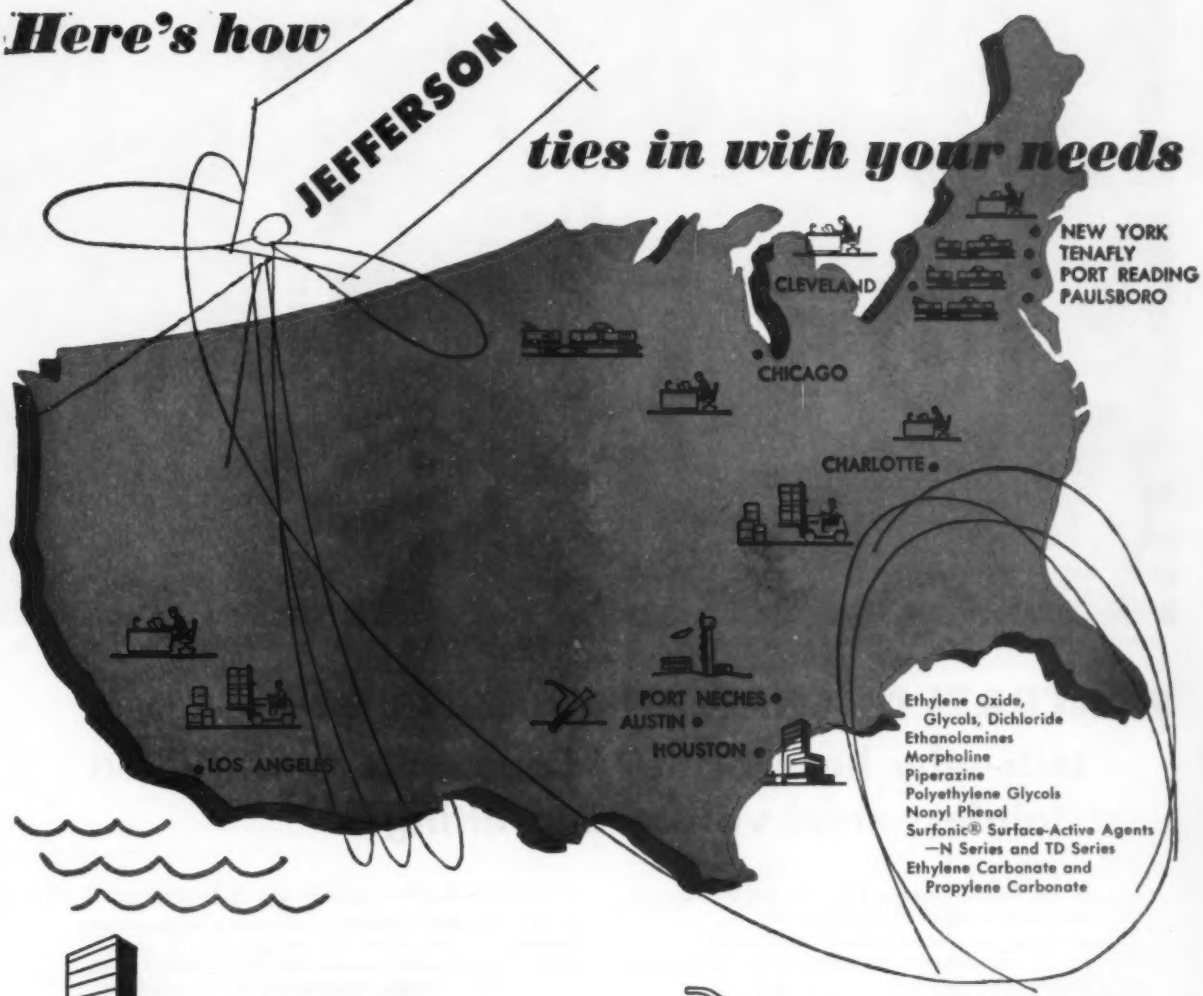

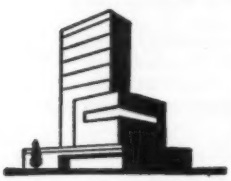

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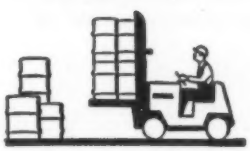
Our sales and technical service staffs are ready to assist you in developing the most profitable applications of our products.



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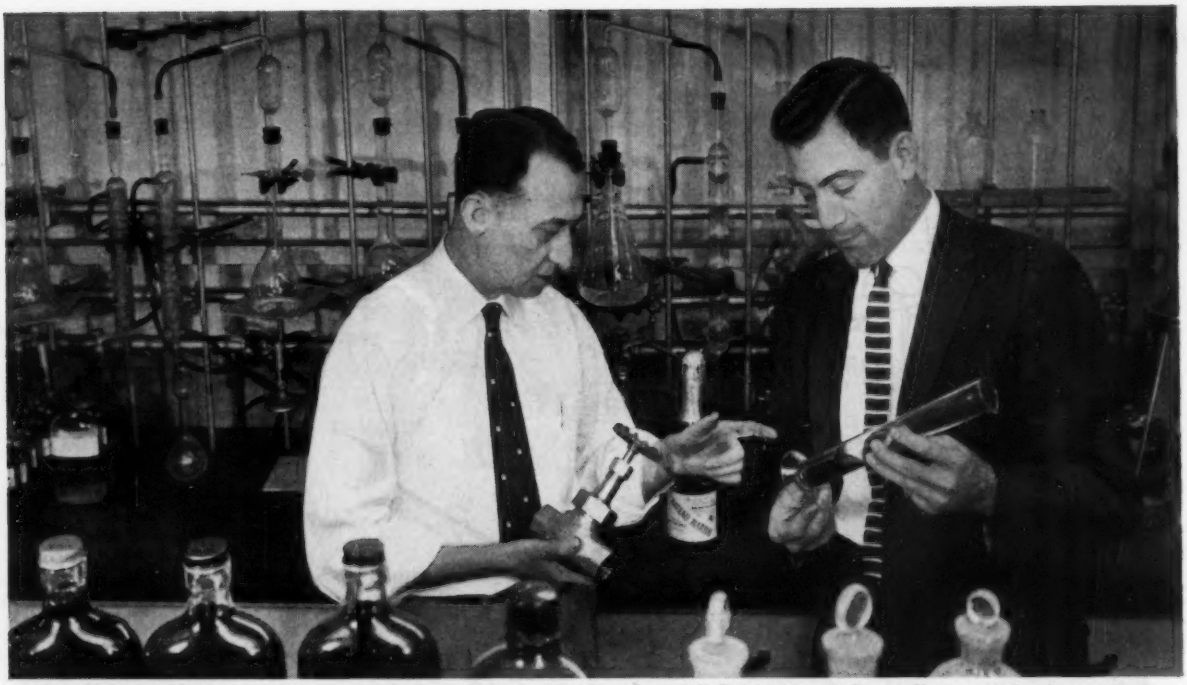


MR. ALEX PANCRAZI (left), Pisa Univ. (Italy) graduate, Chief Chemist, Eastern Wine Corp., Bronx, N.Y. (Right), Michael De Piano, N.Y. representative, Cooper Alloy Corp.

PANCRAZI OF CHATEAU MARTIN (Eastern Wine Corp.) tells why he specifies "Cooper *Alloy Only*" on stainless steel valves and fittings

Q. Mr. Pancrazi, why have you changed to stainless steel valves and fittings at Chateau Martin?

A. To assure product purity. Other metals can cause minute contamination reducing clarity and brightness; stainless steel does not.

Q. What valve model do you find most suitable?

A. After extensive testing, we picked a renewable-disc inside-screw globe valve—Cooper Alloy only.

Q. Why "Cooper Alloy only"?

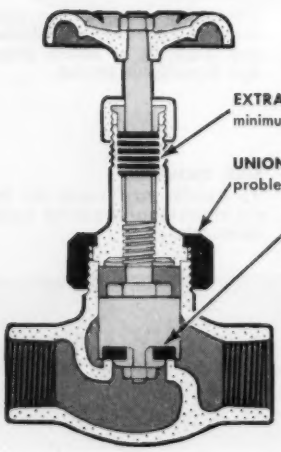
A. Because of three features I find combined nowhere else: renewable retained disc; union-bonnet construction; and extra-deep square-compression stuffing box.

Q. Why is each of these features important?

A. Soft disc gives better seal; retention in metal jacket prolongs its life. When disc replacement is needed, union-type bonnet eliminates difficulties normally found in screwed-in bonnets, removes another threaded joint from product contact. Extra-deep stuffing box with unique square compression reduces maintenance, gives tighter seal at stem.

Q. Don't any competitive valves possess these features?

A. Not one has them all. That's why, to maintain our product contamination-free and to reduce maintenance costs, we insist on "Cooper Alloy only."


EXTRA-DEEP STUFFING BOX holds minimum 6 turns Blue African asbestos
UNION BONNET JOINT eliminates problems found in screwed-in bonnets
RETAINED RENEWABLE DISC for tight seal and long life

COOPER ALLOY Figure 15RD Globe Valve, inside screw rising stem, 200-lb. service, screwed ends, renewable retained disc of composition you specify.

YEARS AHEAD IN DESIGN SUPERIORITY! No matter what your valve type—globes, gates, angles, checks, or Y's—the Cooper Alloy model's outstanding design features will be important to you. Cooper Alloy, with 35 years of pioneering experience in stainless steel, does not merely adapt existing brass and iron valve patterns; it creates valves *designed to be cast in stainless!* **Check the special design features of valve shown at left.**

As the little CA man below is saying: "*You Can Tell A Cooper Alloy Valve As Far As You Can See It!*" Write today for *your* copy of our folder "Design Factors In Stainless Steel Valves." The Cooper Alloy distributor near you will be glad to show you the complete line of Cooper Alloy valves *and fittings*, and their advantages. He can serve you promptly from local stocks.

COOPER ALLOY

Corporation • Hillside, New Jersey

VALVE & FITTING DIVISION

THIRTY-FIVE YEARS OF STAINLESS STEEL PIONEERING

FOR CATALYTIC REFORMING

4 B&W Refractory Castables

with low iron content

B&W Kaocast

Ten years ago, B&W introduced this 3000° castable which offers a combination of high temperature use limit, as well as very low iron content. B&W Kaocast can either be gunned or cast in place.

B&W Kaocrete-LI

After two years of extensive field service, B&W adds Kaocrete-LI to low iron content castables. B&W Kaocrete-LI, which has an iron content of less than 1%, has exceptionally high strength for resistance against abrasion and erosion. It has sufficient refractoriness for use at temperatures to 2700 F. Suitable for both gunning and casting.

B&W Kaolite-LI

Another new castable with over two years of field service, B&W Kaolite-LI has high insulating properties due to its light weight (only 59 pounds per cubic foot). Its iron content is also less than 1%. It is designed to be applied with a cement gun only. Installation and maintenance time can be cut since Kaolite-LI does not require water curing and heat can be applied directly after gunning.

B&W Kaocrete-32

Developed for special high temperature service, B&W Kaocrete-32 has extremely high strength and a use limit of 3200 F. It can be poured, plastered or gunned into place.

Properties of B&W Low Iron Content Castables

		B&W Kaocast	B&W Kaocrete LI	B&W Kaolite LI	B&W Kaocrete 32
Use limit, °F		3000	2700	2300	3200
Melting point, °F		3200	3100	2700	3297
Average density lb/cu ft after firing		126	131	59	134
Average % Fe_2O_3		1.0	0.9	0.8	1.0
Cold crushing strength—psi average—after heating for 5 hrs. at:	1000 F	700	2500	350	1000
	1500 F	500	2500	350	800
	2000 F	400	1200	300	750
	2200 F	500	1300	450	1000
	2400 F	500	1600	—	2000
	2600 F	1000	6000	—	3000
	2800 F	2200	—	—	3500
	3000 F	3500	—	—	4000
	3200 F	—	—	—	5000
Permanent linear shrinkage—average % less than—after heating for 5 hrs. at:	1000 F	0.3	0.2	0.3	0.2
	1500 F	0.3	0.2	0.4	0.2
	2000 F	0.5	0.2	0.4	0.2
	2200 F	0.5	0.2	0.6	0.4
	2400 F	0.5	+0.1	—	0.5
	2600 F	0.5	—	—	0.5
	2800 F	0.5	—	—	0.5
	3000 F	0.3	—	—	0.2
	3200 F	—	—	—	0.1

Consult your B&W Representative for additional information on these and other B&W Refractories for the refining industry.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

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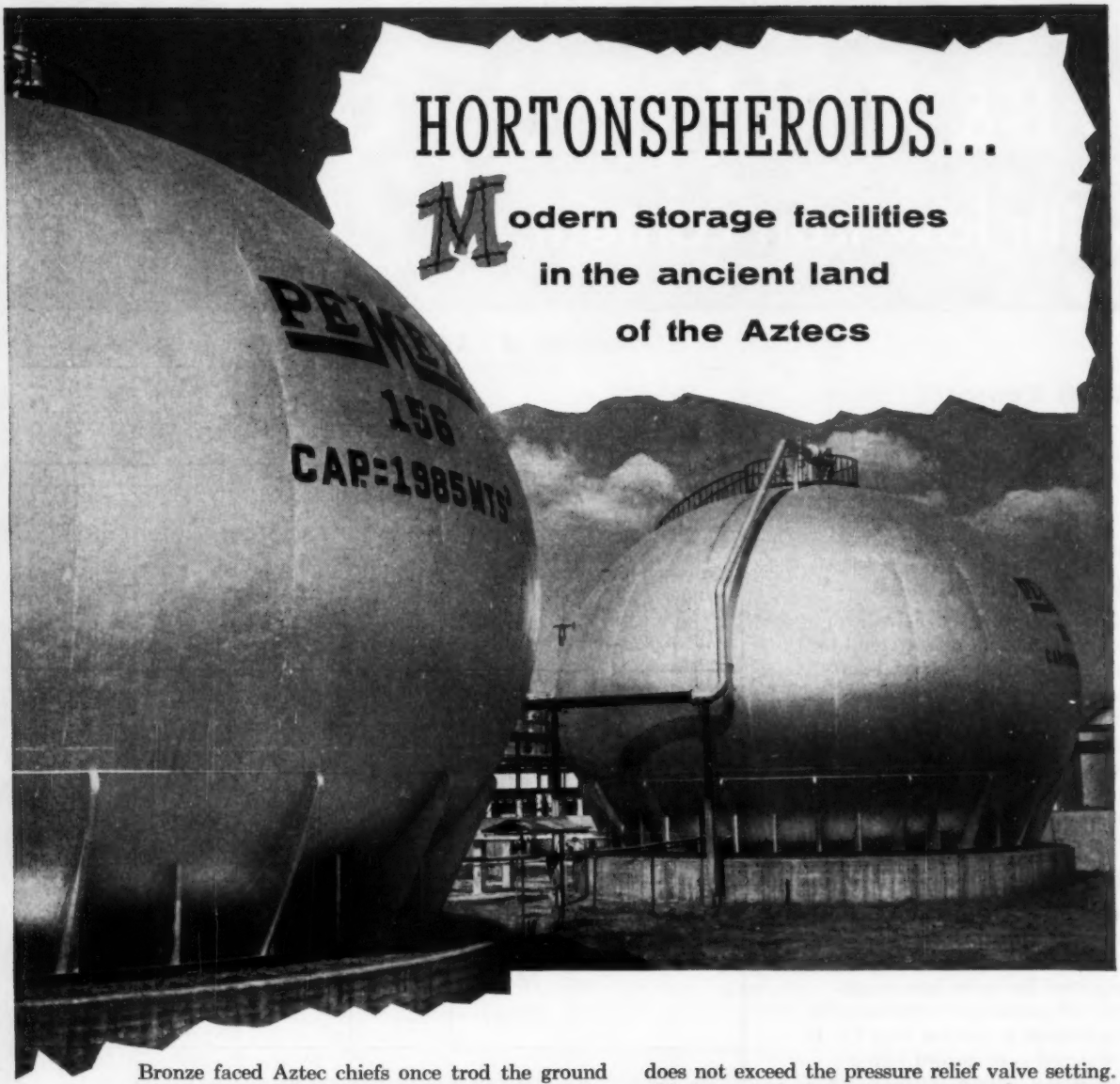

HORTONSPHEROIDS...

Modern storage facilities in the ancient land of the Aztecs

Bronze faced Aztec chiefs once trod the ground where these modern Hortonspheroids® are built. Located at Petroleos Mexicanos Atzcapotzalco Refinery on the outskirts of Mexico City, a city whose foundations were laid on the ruins of an old Aztec temple, these Hortonspheroids provide dependable pressure storage for the refinery's volatile hydrocarbons. No vapor can escape from a Hortonspheroid as long as the internal pressure does not exceed the pressure relief valve setting.

Modern steel plate structures for the pressure storage of volatile liquids are the result of CB&I's *complete* facilities for designing, fabricating and erecting welded steel plate structures to the exacting specifications of the petroleum industry . . . *anywhere in the world!* Further information, estimates or quotations on Horton® structures may be obtained by writing our nearest office.

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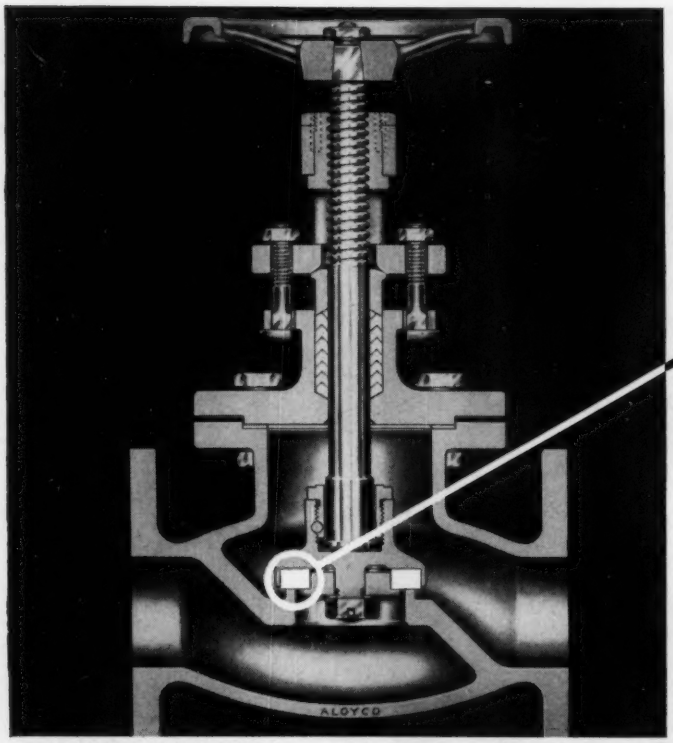
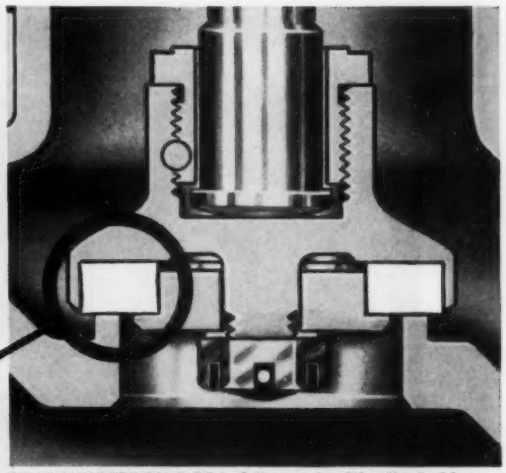


150 LB. ALOYCO GLOBE VALVE features bolted bonnet, and outside screw and yoke construction which keeps stem threads out of contact with corrosive fluids. Two piece gland plates and followers. Sound, heavy section body and bonnet castings. Stainless bolts. Heavy finished stem. Renewable yoke bushing. Flanged or screwed ends.



RENEWABLE TEFLON DISC is fully retained in disc holder so that even heavy overloads can't force it out of place. Machined seating surface assures wide full contact with disc and protects against distortion. Teflon V-type chevron packing rings are also used in deep stuffing box.

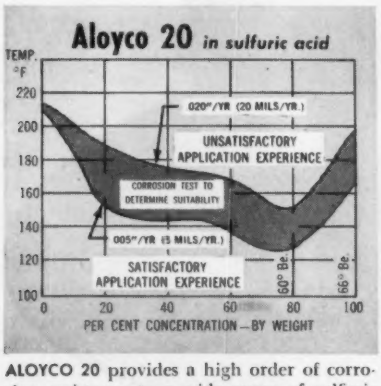
Tips on selecting valves to combat oxidizing solutions

High chromium and chromium-nickel stainless steels are the best alloys for these corrosive applications.

When exposed to oxidizing solutions they form protective films which restrain corrosive attack. Aloyco 18-8S, 18-8S mo and Aloyco 20 are good examples.

Valves should be constructed so that slight wear or corrosion won't require costly valve replacement. Renewable seats or discs shown above are one answer to this problem. So are deep stuffing boxes and outside screw and yoke construction. And, of course, all valve parts that come in contact with the corrosive fluid should be alloy steels. 6.18

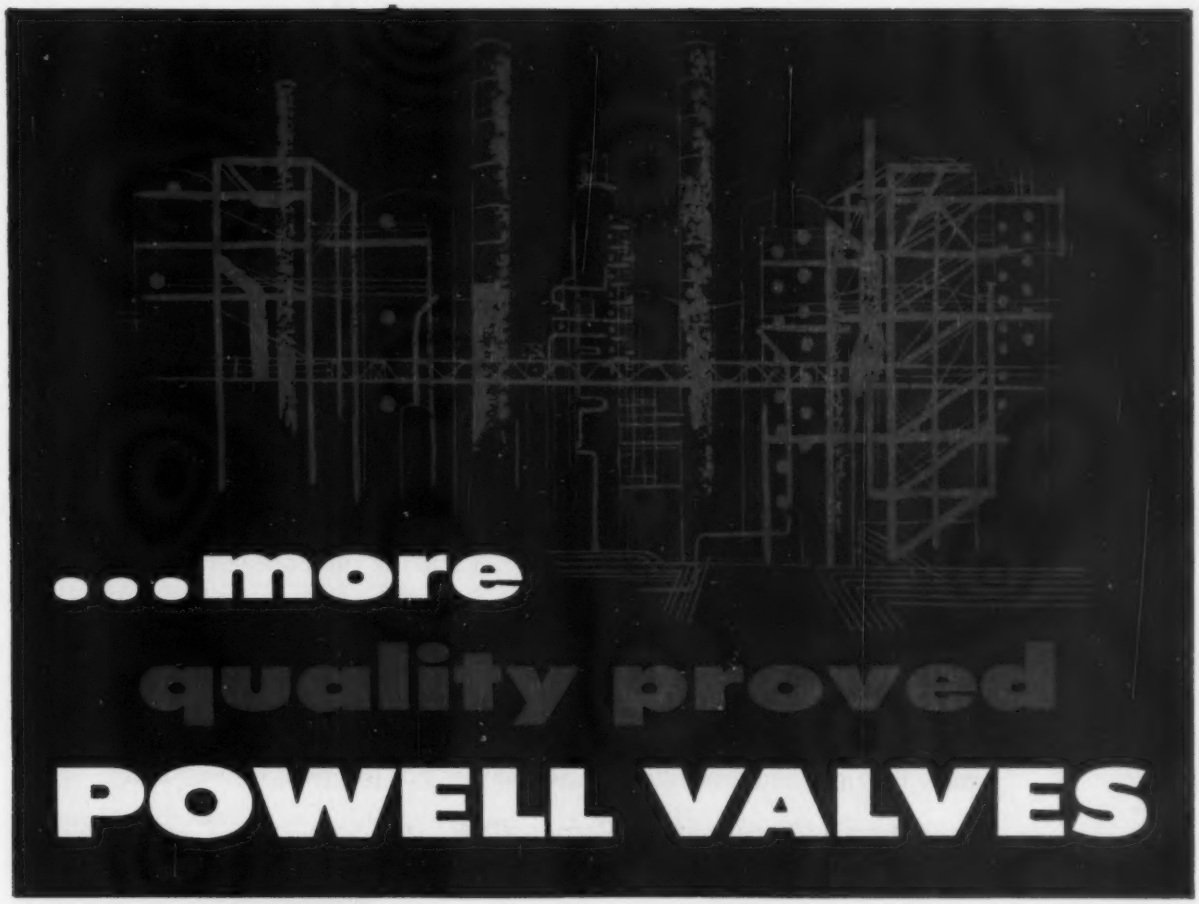
ALOYCO STAINLESS STEEL 18-8S (type 304) is expressly suited for resistance to oxidizing solutions. It also lends itself to innumerable other applications to prevent product contamination or discoloration. In Aloyco 18-8S mo (type 316), molybdenum is added to increase resistance to attack by pitting.



ALOYCO 20 provides a high order of corrosion resistance to a wide range of sulfuric acid concentrations at varied temperatures as indicated by the graph above.

ALOYCO TECHNICAL SERVICE includes engineering counsel, metallurgical assistance and field service. Samples are being prepared for plant line test above.

FOR FURTHER INFORMATION on Aloyco corrosion-resistant valves, write to Alloy Steel **Products Company, 1303 West Elizabeth Avenue, Linden, New Jersey.**



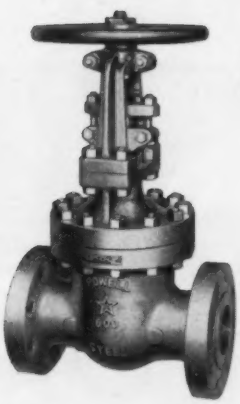


FIG. 6003 SS—Alloy Steel Gate Valve for 600 Pounds W.S.P.

FIG. 3061—300-Pound Steel Swing Check Valve.

FIG. 1563G—Gear Operated Lubricated Plug Valve, 150 Pound Steel.

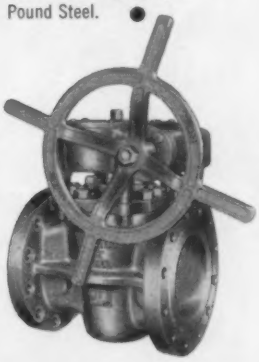
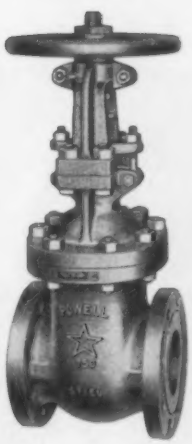


FIG. 1503—150-Pound Steel Gate Valve.



Designed for long life, designed for dependable service

Consult your Powell Valve distributor for all the facts about quality proved bronze, iron, steel and corrosion-resistant valves. For every flow problem . . . there is a Powell Valve to solve it.

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

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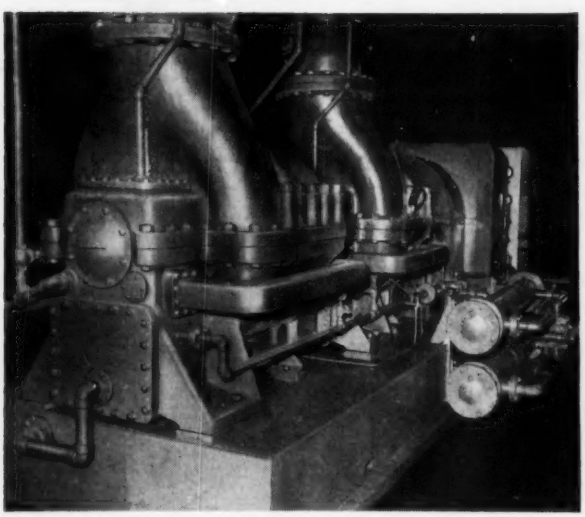
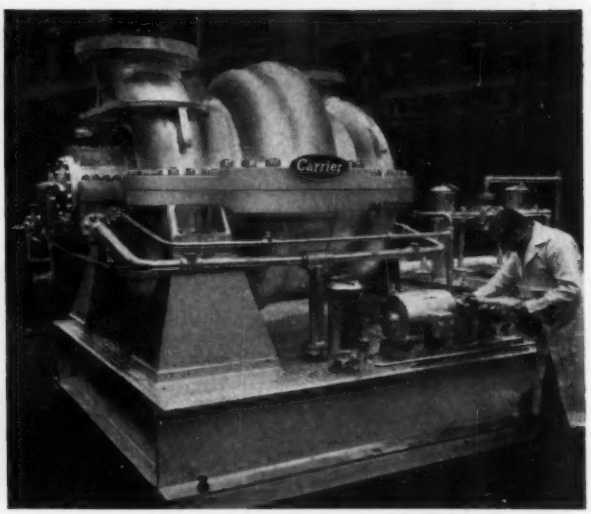
Which is the best way to compress gases against high compression ratios?

There are many factors to consider. Here's one: How many gases are being compressed—one, two or more? With a wide selection of compressors and arrangements, Carrier has the right answer for your application. What's more, with greater experience handling more different gases in its compressors than any other manufacturer, Carrier offers application skill unmatched in the industry. Two of many Carrier compressors are shown below. For complete information about them, call your nearest Carrier office.

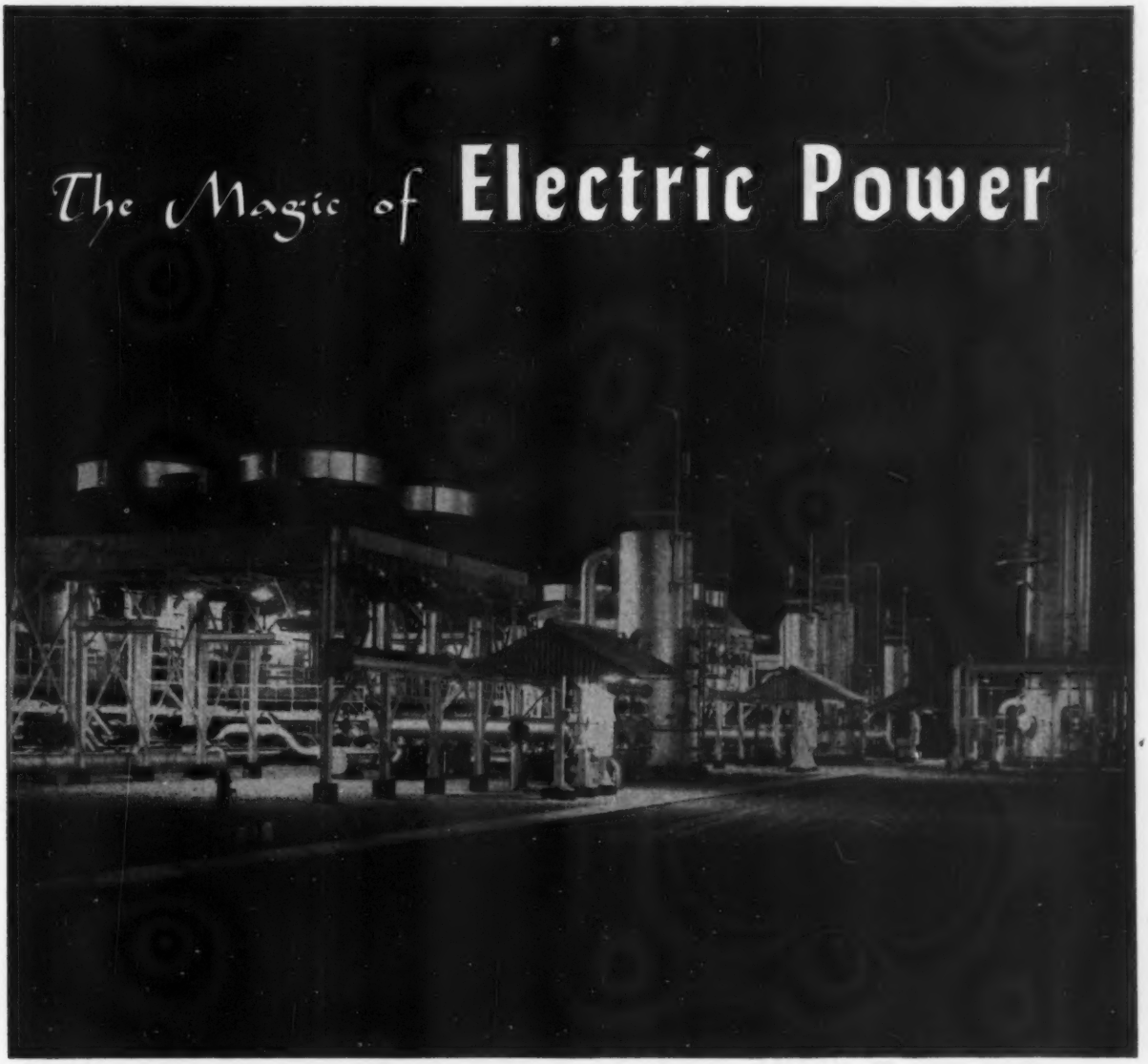
Or write Carrier Corporation, Syracuse, N. Y. Carrier



Where two or more gases are being compressed, a Carrier Drive-thru Compressor is the right answer. Carrier has installed drive-thru units with up to four compressors on one shaft, allowing for intercooling between cases or for the handling of different gases. Well adapted to steam turbine gas engine or electric motor drive, Carrier Drive-thru Compressors can fit into the plant heat balance.



Where one gas is being compressed and intercooling is necessary, a new Carrier Iso-cooled Compressor is the right answer. Designed and developed by Carrier, this new unit has a minimum of accessories and occupies less space than conventional arrangements. In a Carrier Iso-cooled Compressor, the full gas stream is extracted at an intermediate point, cooled externally, re-enters the compressor.



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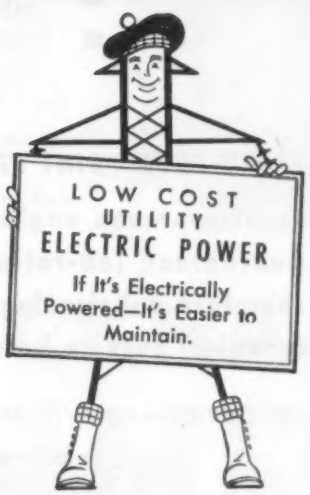

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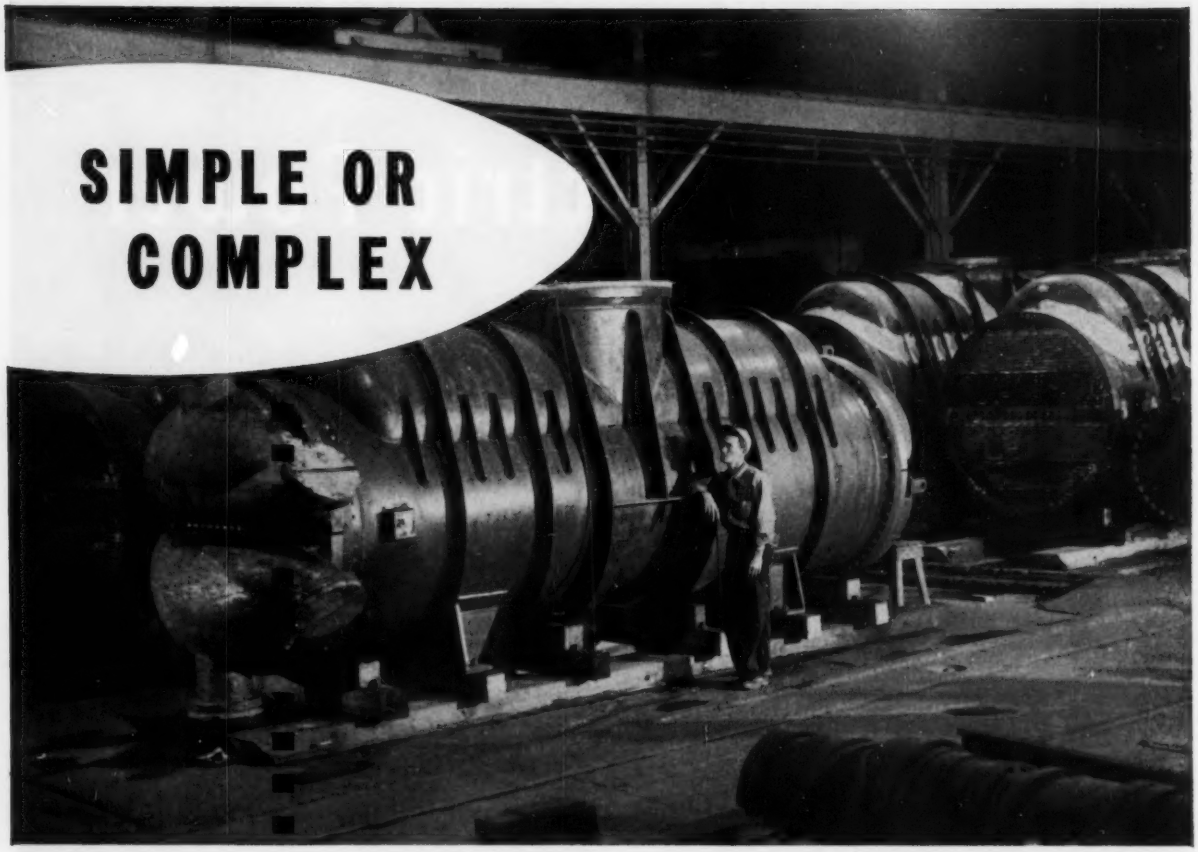

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No job is too complicated for Efco's heat-transfer specialists. One reason that Efco does it *right* is its many years of experience in designing and fabricating heat-exchangers for the wide range of temperatures and pressures represented by ethylene plants and platinum catalyst reforming units. We are recognized specialists in handling all grades of carbon, alloy, and stainless steels, nickel, aluminum, and special low-temperature materials.

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service-proved engineering design
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For half a century, Stockham has produced quality products. Stockham "Know How" in design and manufacture assures dependable performance in steel valves of rugged construction and precision finish.

Stockham steel gate, globe, angle and check valves and Wedgeplug non-lubricated steel plug valves can be supplied in carbon and special alloy steels with a wide selection of trims.

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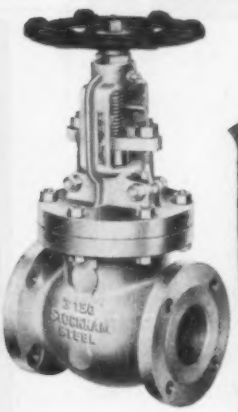
STEEL GATE VALVES



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Wrench Operated
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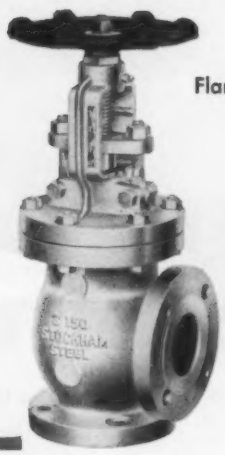
Butt Weld Ends

STEEL ANGLE VALVES



STOCKHAM STEEL VALVES

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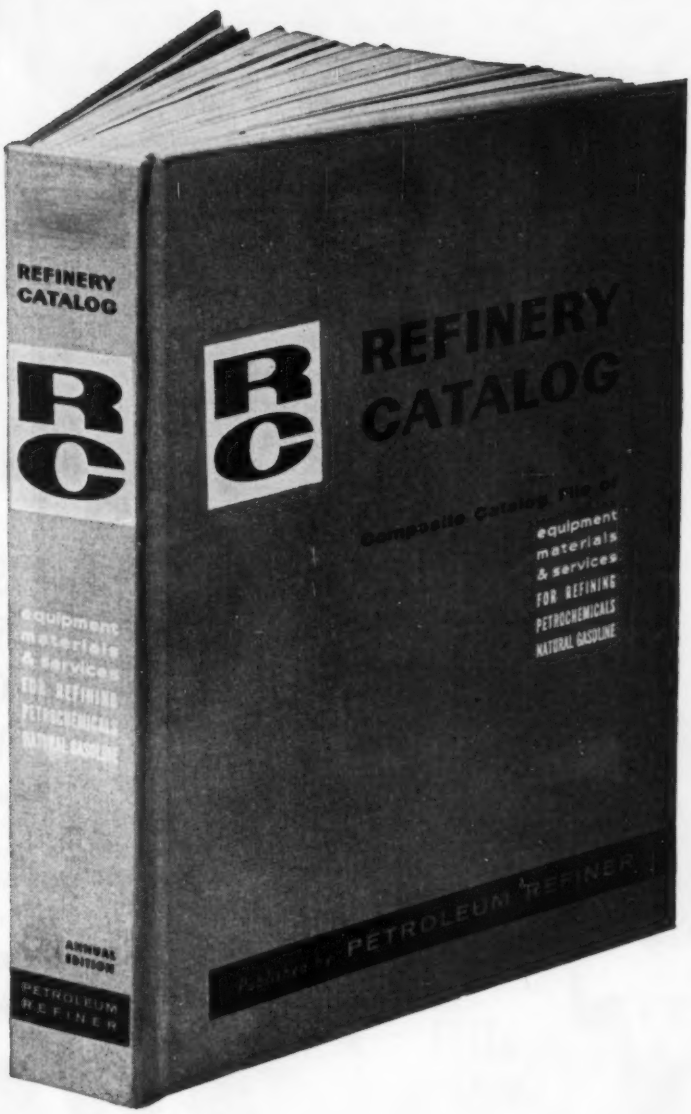

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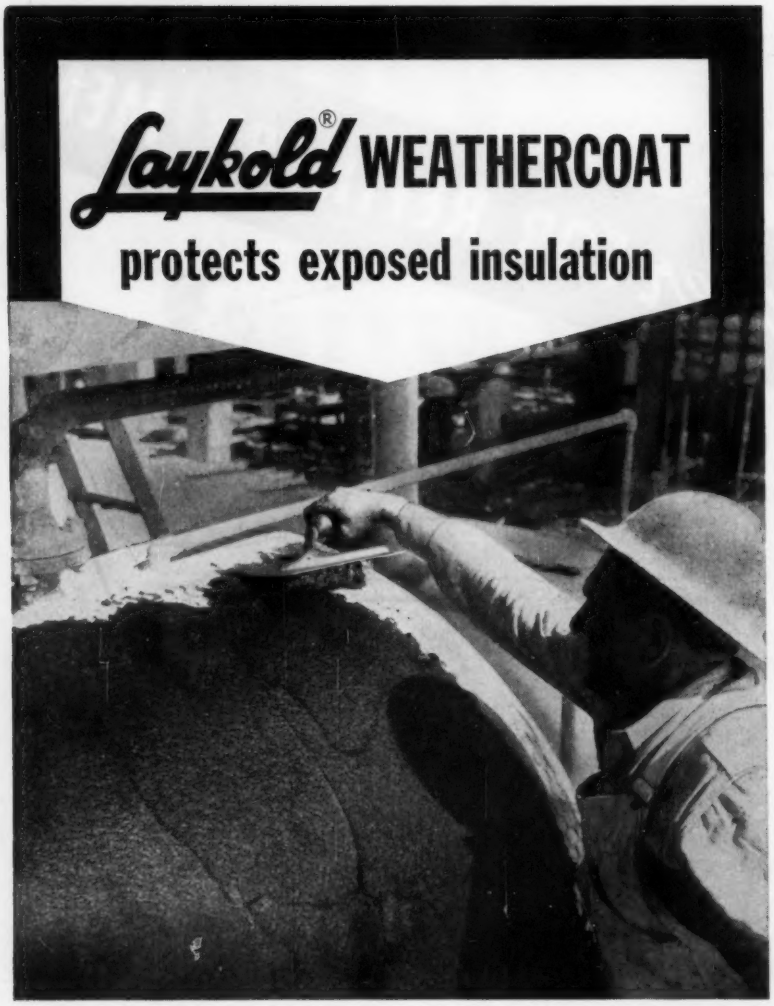

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The Mail Box . . .

Error Noted

To the Editor:

I believe there is an error on page 116 of your February issue. In the article by H. H. Yang on "Programming the Analog Computer" there is an equation derived from the following relation:

$$UA(T - t) = GC_p\,(t - t_o) + WC_p\frac{dt}{d\theta}$$

The final equation then should have a plus sign in the first numerator like this:

$$\frac{dt}{d\tau} = \frac{UAT + GC_p\,t_o}{3600\,WC_p} - \frac{(UA + GC_p)t}{3600\,WC_p}$$

D. A. Duke

American Oil Company
Texas City, Texas

Editor's Note—The author agrees with Mr. Duke.

•

Cost Handbook Ready

To the Editor:

We are interested in receiving one reprint of the article "Want Equipment Costs for Estimates?" (August, 1956 PETROLEUM REFINER.)

Industrial Research Service has advised us their supply is exhausted and that perhaps we might obtain one from you.

We would appreciate it very much if you would mail us a copy of this reprint if you have one available. If there is any charge, please advise.

F. H. Dole
Pilot Plant Superintendent

Reynolds Metals Co.
Bauxite, Ark.

Editor's Note—Due to the interest in the subject of costs, we have prepared a special 50-page Cost Estimating Handbook which is now available at $1 per copy. Send orders to Reprint Department, Petroleum Refiner, Box 2608, Houston 1, Texas.

•

A Strong Case

To the Editor:

We certainly appreciated your thoughtfulness in sending the clipping of "Velvet Ribbon, Not Black Sheep" from "The Look Box" of the REFINER for February. More than that, we are grateful for your all-out support in our own campaign to awaken the parent petroleum industry to the importance of asphalt in the general scheme of things. Asphalt pavements for the great Federal road program offer industry a solution to the nagging question: How can we get the roads we need for greater gasoline sales without inviting a crushing burden of gasoline taxes?

You made a strong case for asphalt in the February issue and it's bound to leave its imprint on some important minds in the industry.

Glynn Harvey
News Editor

The Asphalt Institute
College Park, Md.

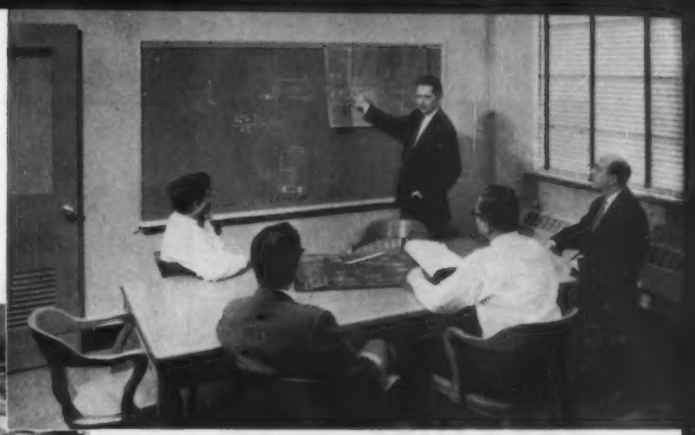
•

INVITATION!

Petroleum Refiner editors invite your comment and criticism. We are always delighted to hear from our readers. Address us Box 2608, Houston 1, Texas.

For more data on advertised products, use Readers' Service Cards, last page.

PROBLEM



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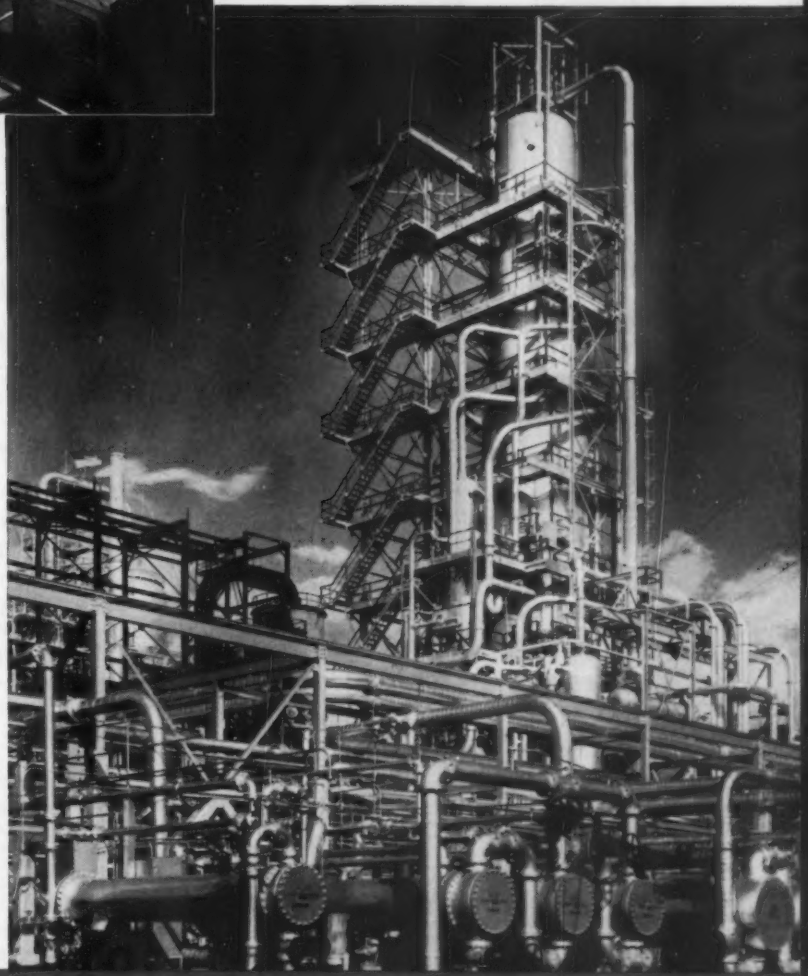

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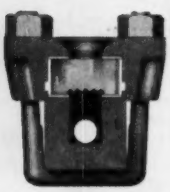

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If Oil Could Speak

If oil could speak it would have many fascinating truths to tell the non-oil public—truths that would win thousands of new friends for the oil industry.

But, oil can't speak—you can. You, as an individual, can win many new friends for the oil industry if you will pass the true facts on to your non-oil industry friends.

Here are some of those true facts. They are being presented for one purpose: To keep you posted on your industry, so you can tell the story oil is unable to relate.

Read these facts. You will find them informative—and interesting.

"If Oil Could Speak" it would tell the American public:

•

• Experience has shown that an average production rate of 9 percent of reserves can be safely maintained. Thus, to produce an additional barrel of oil to satisfy one barrel of new demand, the oil industry must discover 11 barrels of reserves.

•

• Cost of finding new crude reserves is increasing. The higher finding costs result from the greater difficulty experienced in finding oil, higher labor and material costs and the fact that the average depth of all new wells drilled is increasing.
Within the last 15 years the average depth of all new oil wells drilled has increased 38 percent. And the cost of drilling a well increases according to depth as follows: Cost per foot at 4000 feet—$12.50; cost per foot at 8000 feet—$17.00; 12,000 feet—$26.50; 16,000 feet—$153.00.

•

• One out of every four development wells are dry holes.

•

• In one year the oil industry risked $3.3 billion on oil exploration and development—and $.5 billion to equip wells and leases for a total of $3.8 billion. This compares with about $8 billion spent in the same year for new plant and equipment by all manufacturing.
Of the $3.3 billion risked by the oil industry, about $1.8 billion proved to be successful investments and about $1.5 billion was lost. This $1.5 billion lost represented about 25 percent of the gross income realized by operators after payment of royalties. Such odds, even with a tax offset, assuming income to cover them, become a critical factor.

•

• In no other industry is the risk of capital loss so great. Example: In most industries a capital outlay of X dollars will bring to the investor a factory or plant of approximately X value with a known life of utility and productive capacity. In the oil industry a capital outlay of X dollars in a wildcat will result in a dry hole 9 times out of 10—or a million-barrel oil reserve 1 time out of 44—or a 10-million-barrel oil reserve 1 time out of 200.

•

Remember: Oil can't speak—you can. Only you can give the non-oil public the true facts about your oil industry.

A Quick Look at the Industry THIS MONTH

Small Refiner Fights Back . . .

Independents will make all out effort to improve competitive position in coming months. They have to—mounting costs, threat of gasoline price cuts, government restrictions have small refiners walking precarious economic tight rope. **Harbinger of struggle ahead:**

- **S-11.** Robinson-Patman law is facing stiff opposition from small refiners. Law proposes to erase price cuts to meet competition on local basis if it creates monopoly or knocks out competition. Independents say it would seriously curtail their ability to compete—would force higher gasoline prices to consumer.
- **Gasoline Price Cuts.** Small refiners are waging spirited campaign to prevent rollback of recent gasoline price increase—unless crude prices are decreased proportionately. Say they will be snuffed out of business if such situation arises on top of current price increases, mounting cost of steel and chemicals.
- **Weighted Averages.** Small refiners are asking government to use cut-off price instead of weighted average in "set-aside" jet fuel purchases. Reasons: Under present set up, if refiner entitled to set asides refuses to sell at weighted average of regular bids, government can pay higher price to large refiners. In one of several instances, Vulcan Asphalt Refining sold 70,000 gallons of jet fuel at 10.25¢ under regular contract, then received just 9.44¢ for 680,000 gallons of set-aside.

Government estimates it will purchase 21.1 percent of all its oil requirements from small refiners in '57. Value: $200 million.

—•—

Wage Costs On the Rise . . .

Oil, Chemical and Atomic Workers Union says "Six percent wage boost (27¢ an hour) or we strike." Early industry proposals indicate four percent boost is more in line with Eisenhower's plea to hold back on wage increases.

Hurling charges of "arrogance," OCAW has forced Socony Mobile's 29,500-bpd Trenton, Mich., refinery to shut down because of driver-bulk plant strikes—threatens to strike against small refiners who supply seven major marketers in Detroit area.

By May 1, 80-90 percent of OCAW contracts in 15-state bargaining area will be open for new wage talks.

—•—

Refining Outlook . . .

Uncertain. Expected easing of Europe oil lift, slackening of winter oil demands will necessitate substantial cutback in product supply before summer. Gasoline stocks remain high, putting new price level in vulnerable position.

Predictions for '57 over-all product demand remain bright—up 4½ percent over '56.

—•—

Postings on Octane Race . . .

Makers of tetraethyl lead are increasing price to refiner by 2 to 3 percent—another strong indication that cost of upping octanes will continue to climb.

Two more marketers are saying "nix" to three-grade trend. Atlantic Refining elected to stay with two grades, boosting octane rating and price of its super premium. Ohio Oil says its two grades will supply all power and performance needed by today's cars.

—•—

Engineering Trends . . .

Engineering graduates are increasing—but not as fast as expected. 1955-56 graduate total: 31,621, ten percent under expectations. 27,567 engineers were graduated in 1954-55—only 57 percent of students who started out as majors in the field.

What's New in Petrochemicals . . .

Prediction: Needs of petrochemical industry will boost demands for acetylene 12 to 15 percent in '57. Last year, booming plastics, solvents and synthetic rubber business helped push acetylene production over 724-million-pound mark. Supply is good—carbide acetylene production is already available and additional natural gas capacity is being built.

Petrochemicals can look to bright future in plastic emulsion field. Reason: Acrylics. Market for acrylic paints is growing fast. They are extremely durable, fast drying, with good color and no paint odor. Other advantages—water resistant, do not show water spotting, can be applied to damp surfaces and at lower temperatures than other latex paints.

Standard Oil (Indiana) is widening its petrochemical market. Recently bought all outstanding common stock of Schrock Brothers, producer of anhydrous ammonia.

—•—

New Uses for SO_2 Extraction . . .

Look for advances in SO_2 extraction of oil products. Badger Manufacturing announces work in this field with possible applications of aromatic purification, reduced pressure extraction and duo-solvent techniques.

—•—

Cool Off With Heating Oil . . .

Hot weather demand for distillates may soon be on the upswing. Reason: Major marketer will soon offer consumers oil-fired heating and air conditioning system. Field tests show unit's operating cost is competitive with heating-cooling systems using other fuels. Advantages: Silent (has no moving parts)—easier to maintain—more efficient than present systems—will offer ten-year unconditional guarantee.

Industry predicts 1.2 million central heating-cooling systems will be in use by '65. Each oil-fired unit will use about 40 barrels of heating oil per year.

—•—

Illness Bites the Pocketbook . . .

Each year, prolonged illness and job absence costs industry employes 13 percent of their income—$800 million in lost wages, plus personal medical expenses. Almost $2 billion in production time is lost annually from this cause.

Five-year study shows prolonged illness hits 39 out of every 1000 employes. Average length of illness: 10.9 weeks. Most common causes: Diseases of digestive system (hernia, appendicitis, ulcers)—23.6 percent. Circulatory diseases—12.9 percent. Accidents, poisonings, violence—11.1 percent.

—•—

Oil's New Competitor? . . .

Most provocative development in fast growing boron chemistry field: Potential use of boranes (boron-hydrogen compounds) as high energy fuels. Some boron-based fuels are said to produce extraordinary power in relation to their weight (boron is one of the lightest elements).

Researchers say it shows great promise as fuel for rocket or jet motors in missiles and supersonic aircraft. However, present high production cost will probably restrict it to military use.

—•—

Asphalt Boom on the Way . . .

Look for asphalt demand to jump in '57 as government highway program gets underway. Expected requirements for asphalt and road oil: 18.5 million short tons, compared with 17 million in '56. 13-year program is expected to use up 127.7 million short tons of asphalt.

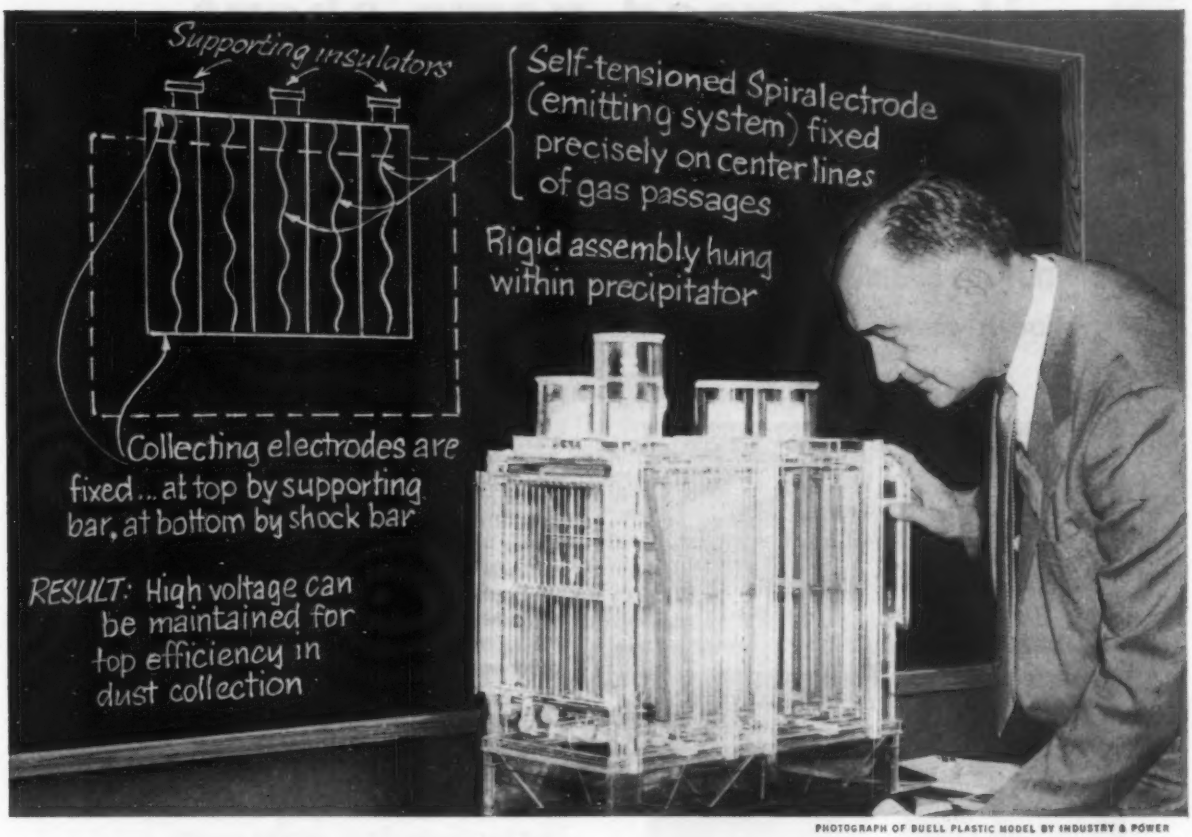
Total sales of asphalt did right well in '56—93.1 million barrels were used, up 8.4 percent over '55.

—•—

Wildcats Show Promise . . .

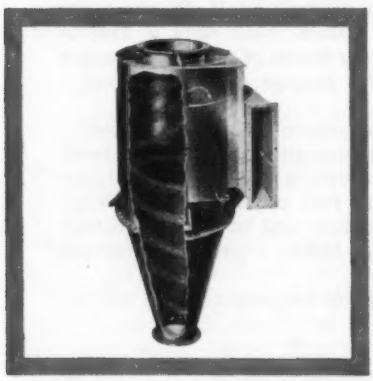
Sixty three new oil fields were opened in the U. S. during February. Four of the most promising: Payne Johnston et al's Smith County, East Texas, discovery flowing 650 barrels of 33-gravity oil daily; Humble's find in Lea County, N. M., good for 350 barrels of 40-gravity; Texota Oil's Musselshell County, Montana, strike making 430 barrels of 33-gravity; and Gulf's offshore Louisiana well testing 400 barrels of 30-gravity oil per day.

How fixed electrodes assure top efficiency in a Buell "SF" Precipitator

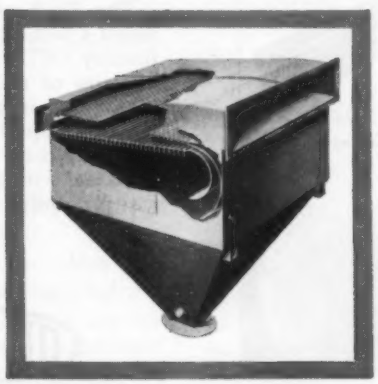

Supporting insulators
Self-tensioned Spiralectrode (emitting system) fixed precisely on center lines of gas passages
Rigid assembly hung within precipitator
Collecting electrodes are fixed... at top by supporting bar, at bottom by shock bar
RESULT: High voltage can be maintained for top efficiency in dust collection

PHOTOGRAPH OF BUELL PLASTIC MODEL BY INDUSTRY & POWER

Even when high-resistivity dusts must be collected, top efficiency is guaranteed by the exclusive shape of Buell's Spiralectrodes—proved to give 50-100% greater emission than straight wires. Exclusive Continuous Cycle Rapping virtually eliminates maintenance by keeping electrodes constantly clean.



Buell Cyclones also assure top efficiency with large diameter design to eliminate clogging . . . and by harnessing double-eddy and putting it to work.



Buell's Low Resistance Fly Ash Collector combines top efficiency to meet present strictness, with low draft loss for natural or mechanical installations.

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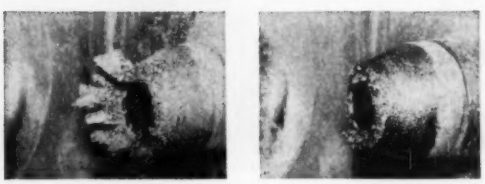
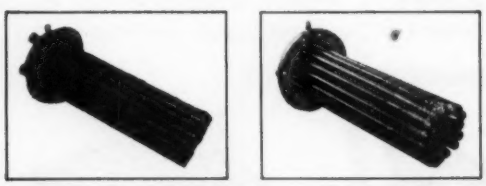
RESIDUAL FUEL

Du Pont additive proves outstanding as a dispersant, cleans sludge-laden tanks, keeps burner nozzles, filters and strainers clean

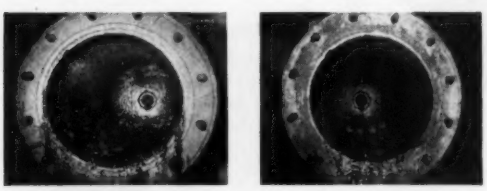
STRAINER-PLUGGING . . . solved by FOA-2



NOZZLE-FOULING . . . solved by FOA-2



PREHEATER TUBE-FOULING . . . solved by FOA-2



PREHEATER-SHELL-FOULING . . . solved by FOA-2

Du Pont Fuel Oil Additive No. 2 has been proved a highly efficient sludge dispersant for residual fuels. In every test, the additive has succeeded where other—and often much more costly—methods have failed. Our own experience, in Du Pont manufacturing plants, has repeatedly confirmed these findings.

FOA-2 has cleaned many tanks too sludge-laden for operation, and the dispersed sludge has been burned without furnace shutdown. After these cleanings, the continued use of FOA-2, in small concentrations, has *kept* nozzles, filters and strainers clean, practically eliminating fouling and reducing the need for expensive tank cleanings to an absolute minimum. Being nonmetallic, FOA-2 itself burns completely, leaving no ash.

Users get all this protection, all this insurance against operation failure, with only a minute quantity of FOA-2 per barrel of oil. Storage space is kept available for storage of residual fuel—*not sludge.*

The Du Pont Petroleum Laboratory recently issued a technical memorandum (No. 317, dated January 1957). It reports in detail ten typical case histories of residual fuel problems solved with FOA-2 . . . in a refinery, and in large industrial plants, an apartment house, a power station and a country club.

Phone, wire or write for your copy. It will be sent promptly.

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How to Say *No* with a *Yes*

LAST YEAR PRESIDENT EISENHOWER said *yes,* legislation to free natural gas producers from federal control is essential. Then he vetoed the Harris Bill.

Last month the President again said *yes,* producers should be freed—and again he said *no,* the administration is not going to send a new natural gas bill to Congress.

These diametrically opposed mental actions strongly indicate that the natural gas producer may be left strangling in the red tape of government regulation for some time to come. Adding fuel to this thought is the fact that the sponsors of the Harris Bill, Senator Fulbright and Representative Harris, both responded emphatically to the President's latest statement: No new action will be forthcoming from them. Initiative for another bill will have to come from the White House.

To make matters worse, at this point no one seems to know what the President wants, what sort of bill he will support—and not veto. Until a specific White House stand is taken, there is little hope of new action being approved, including the bill put into the hopper late last month by Representative Bruce Alger (Texas).

The President probably is sincere in the stands he has taken. However, there is serious doubt that he was given an opportunity to weigh fully the producers' side of the issue. It is hard to believe he possibly could have had all the facts, for they paint a far from pretty picture:

Plant Construction Is Down. In 1953, natural gasoline plant expenditures totaled $125 million. In 1954, the year of the ill-fated Supreme Court decision, expenditures were $100 million. In 1955, the total nose-dived to $50 million.

Granted, the big reason for the construction drop can be traced to natural gasoline no longer being a premium blending stock. However, there is another factor that cannot be forgotten: Plant owners must have a reasonable product price to make a profit. At one time this was a common procedure under the free enterprise system.

Things have changed since June of 1954. Natural gas profits have been checkmated at every turn. There is no business in existence today that can figure its economics of operation on selling a product at a certain price, then have the government arbitrarily set another price at or below the profit level.

Producers and natural gasoline plant owners have faced this perplexing problem many times since 1954. It has forced them into taking one of three unhappy alternatives—go out of business, hold back operations until freed from government control (not many can afford this), or sell only in intra-state commerce.

Disregarding the first alternative, which could bring disaster to all concerned, let's see what has happened to the other two.

Producers Are Forced to Hold Back. It costs the producer an average of 7.79 cents per mcf to bring natural gas to the wellhead. He sells the gas at an average of 8.5 cents per mcf (the interstate deliverer gets an average of 23.5 cents—the residential consumer pays an average of 89 cents).

Add to this the mounting cost of providing the Federal Power Commission with bales of paper work (up to 30 pounds for every transaction) and it is easy to see why independent and major producers alike are reluctant to market their findings to interstate customers. The cost of adding personnel to handle FPC work is no small overhead item.

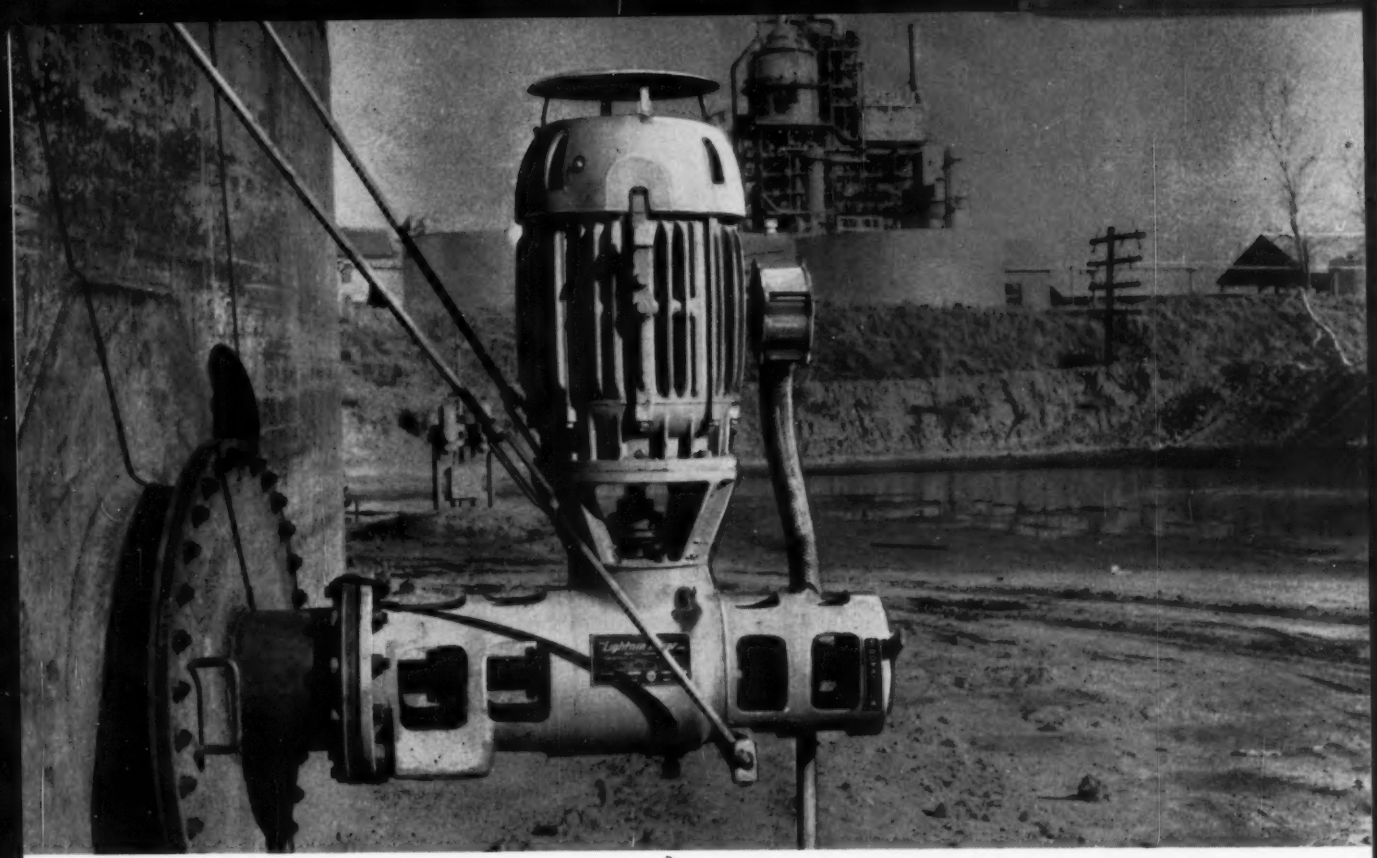
It is hurting the producers to hold back. They can't make a living not selling a product that cost hundreds of thousands of dollars to find and develop. It is hurting the consumers in non-gas producing states. They can't buy an inexpensive, efficient fuel they can't get. So what happens?

The Mountain Goes to Mohammed. Those who can—the gas consuming industries—are losing no time locating new plants in gas producing states.

There are now 70 petrochemical plants in the Gulf Coast area—and they manufacture nearly 85 percent of the nation's petrochemical products. At the beginning of 1956, a single 100-mile-wide strip along the Gulf Coast had an investment of $1.9 billion in petrochemical plants. New construction totaled another $75.5 million. For the 1956-58 period another $29.1 million in expansions are planned.

Texas produced about 400 million of the 500 million pounds of polyethylene produced in the U. S. last year. It was worth about $150 million to the state—$200 million to the nation. And look for the figures to be higher in 1957.

Other chemical industries are following the same pattern. They are playing it safe by picking sites in



Why you **never** *have to repack this mixer*

This idea can save you, eventually, nearly every dollar you spend to service mixer stuffing boxes on your big tanks.

There's no stuffing box on this LIGHTNIN Mixer! Instead, a rotary mechanical seal stops leakage—and stops it for *years*—without need of adjustment.

Replace seal in minutes

Better yet, you can replace *this* seal in a hurry if you ever need to.

You don't have to dismantle the mixer to replace it.

You don't have to remove the mixer from the tank. You don't even have to *drain* the tank.

And you don't need a bevy of skilled specialists; it's a one-man, one-wrench job.

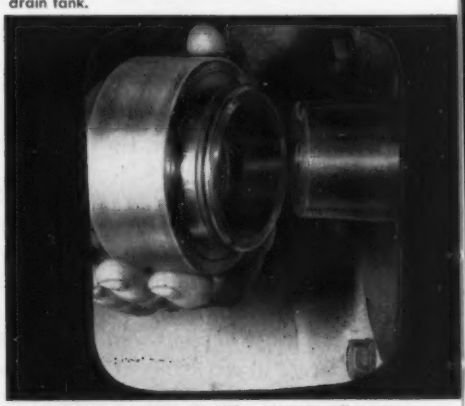
You slide the one-piece LIGHTNIN seal cartridge off the uncoupled mixer shaft. Slide a new cartridge in place, secure it, recouple the shaft—and you're back in business.

Only LIGHTNIN has it

You get the LIGHTNIN seal as optional equipment on any new LIGHTNIN Side Entering Mixer. You can get it to handle the toughest operating conditions —or the simplest.

It's saving refiners many thousands of dollars per year on mixer maintenance. How much can it save *you*? Call your LIGHTNIN Mixer representative (listed in Refinery Catalog) for the full story. Or get facts by mail: send us the coupon for 8-page fully illustrated bulletin.

1. IF YOU EVER NEED TO REPLACE a LIGHTNIN shaft seal, here's how fast you can do it. Close mixer shutoff to hold liquid in the tank. No need to drain tank.



2. UNCOUPLE MIXER SHAFT and slide off seal cartridge. Slide new cartridge on. Mixer shaft automatically realigns itself when recoupled. Job takes minutes only; requires no special skill.

Lightnin® Mixers

MIXCO fluid mixing specialists

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- ☐ B-102—Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP
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- ☐ B-108—Portable: ⅛ to 3 HP
- ☐ B-112—Laboratory and small-batch production types
- ☐ B-110—Condensed catalog showing all types
- ☐ B-107—Data sheet for figuring mixer requirements

Check, clip, and mail with your name, title, company address to:

MIXING EQUIPMENT Co., Inc., 164-d Mt. Read Blvd., Rochester 11, N.Y.

In Canada: Greey Mixing Equipment, Ltd., Toronto 10, Ont.

gas-producing states, thus skirting the danger of having a costly new plant shut down due to natural gas producers' possible future inability to serve them because of government control. The intra-state market is on the move—to the producers.

To illustrate further the intra-state trend, 27 years ago Texas marketed within its borders only 25.7 percent of the natural gas it produced. The percentage was 52.1 in 1955.

Added together, these facts put real muscle into the prediction made before Eisenhower's veto: As long as the federal government controls wellhead gas prices for interstate shipment, intra-state commerce is going to boom in the gas producing states. In the long run the residential natural gas consumer in non-gas producing states—the ones who helped defeat the Harris Bill—will be the losers.

Not one natural gas producer wants to keep his product within the borders of his state. He fully realizes his responsibility to serve the nation. But, he can hardly be expected to sell his product at a loss. This is nothing but plain and simple economic horse sense.

Please, Mr. President, look at all the facts. Weigh them carefully—then, for the natural gas producers', the consumers' and the nation's sake, say *yes* with a *yes!*

April's Demand to Dip Normally

CONSUMPTION OF OIL in the U. S. during April will be considerably lower than it has been in recent months. This is not intended to be a startling or unique observation, but it is a reminder that this year will be like all its predecessors in this respect. This following of normal seasonal trend will result from slackening of winter's heavy fuel oil needs, and because it is too early for the summer's high gasoline consumption to start taking up the slack.

As demand goes, so should refining rates. Recent weeks have seen refinery runs being made at too high a level to be continued. However, reports on the latest week show a slight downward movement, which if carried a little farther and allowed to stay a while, will keep inventories in good position.

During the week ended March 22, daily refinery runs averaged 7,976,000 barrels, and that represented a slight drop from the three prior weeks when more than 8 million barrels were processed daily, and substantially less than the 8,205,000 a day refined during January.

This reduction has greatly improved the supply-demand relationship of gasoline.

Gasoline stocks are now large enough, and need not grow additionally to meet needs. That this may be actually what will happen is indicaated by the fact that the latest count showed inventories have just about come to a standstill. Gasoline consumption will soon start siphoning off these supplies, and this year's motoring is expected to require a record amount of fuel.

An Instrument For YOU to Use—

We're Flattered . . .

. . . by the thousands of reprints that have been ordered and the compliments that have been passed along on the supplement, "The Facts About Oil Prices," included in the March issue of PETROLEUM REFINER.

"It should go a long way toward acquainting oil men with the facts concerning the price of oil," writes the president of a major oil company.

That is one of the purposes . . . but the aim is even broader . . . and is supported by further comment from the same executive. *"It should do even more to help those understand it (price of oil) who are not as familiar with the subject as oil people. . ."*

Some who have ordered reprints . . . major companies, independents, individuals and associations . . . have indicated that the pamphlets will be given to their employes to pass along to friends outside the industry . . . the grocer, the baker and the milkman. *"It is more effective when presented by someone known to you,"* says one person, *"than if it merely comes through the mail from an unknown party."*

The supplement was prepared with non-oil people in mind. It will be most effective if put into the hands of the general public. The idea of making it available to employes to pass to friends and neighbors is one good way of accomplishing this. If this is done on a wide enough basis the message can be carried to millions of people. The marketing division has an especially fine opportunity in non-oil producing states, because this is where the industry's public relations is the poorest and the marketing division is the only part of the industry operating in such areas.

Some companies are including the pamphlet in annual reports. Others are distributing it to dealers and jobbers.

An API official writes: ". . . *a superb job . . . one of the finest anyone has come up with . . .*" We are justifiably proud of having had a part in spreading the real oil price story . . .

. . . But We're Not Satisfied

"The Facts About Oil Prices" is already in its third printing. We want to print more.

The need is obvious. And as long as this pamphlet will help fill this need, we'll furnish reprints at our printing costs . . . in the hope even more copies will reach the millions outside the oil industry who help formulate public opinion. Quantities under 100, 10 cents each; from 100 to 1000, 7½ cents each; over 1000, 5 cents each; over 10,000, 4½ cents each; over 20,000, 4 cents each. Send order and remittance to

Gulf Publishing Company,
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A dangerous place to work...

that's why you see so many symbols of safety

Here's a plant that's out to keep "employee downtime" at a minimum. Extinguishers and gas masks provide protection against fire and toxic fumes. Guard rails and chains surround permanent hazards. Raised steel strips around floor openings prevent objects rolling or being kicked to the floor below. Clean windows and bright lighting provide good visibility. It's only natural that a company so interested in safety should select Blaw-Knox Electroforged® Steel Grating for "underfoot" safety.

Each section of Blaw-Knox Steel Grating is of rigid, one-piece construction. Choice of cross bar and bearing bar designs and spacings affords maximum safety under all working conditions. Indoors or out, you get safe, quiet, long lasting and self-cleaning flooring with maximum passage of light and air.

Blaw-Knox Electroforged Steel Grating is fabricated in a wide selection of materials to exact customer specifications. Fits easily and neatly into even the most congested areas.

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• a Special Report

Natural Gasoline developments

New solutions to problems faced by gasoline plants today mean a brighter future for the industry. The following articles show how these problems are being solved by the experts.

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a Special Report

Natural Gasoline

Take a Look at the Automated

The plant of the future will have a radically different control system even though the external appearance may not change much. Here are the four steps to automation.

Ira C. Bechtold, Consultant,
La Habra, California

THE NATURAL GASOLINE plant of 1975 may not have an external appearance much different from that of the plant of 1957, but its control system will differ considerably from those of present day installations. The accelerated pace of process development and the fast moving accomplishments of control systems engineering can be expected to have an increasing impact on natural gasoline plant design contemporaneous with that which is being experienced in other process industries like chemical manufacturing and crude oil refining. Application of existing techniques will provide the plant with a new "nervous system" as well as a "brain."

This study concentrates on the changes which may be expected in process control; points out some of the elements of control which will become necessary to plants of the future; and describes the general nature of the control system of the plant of 1975. However, it's important first to take a look at recent developments in processes which may affect the over-all process schemes and control systems in gasoline plants. Equally important are the economic factors which will influence the use of such processes.

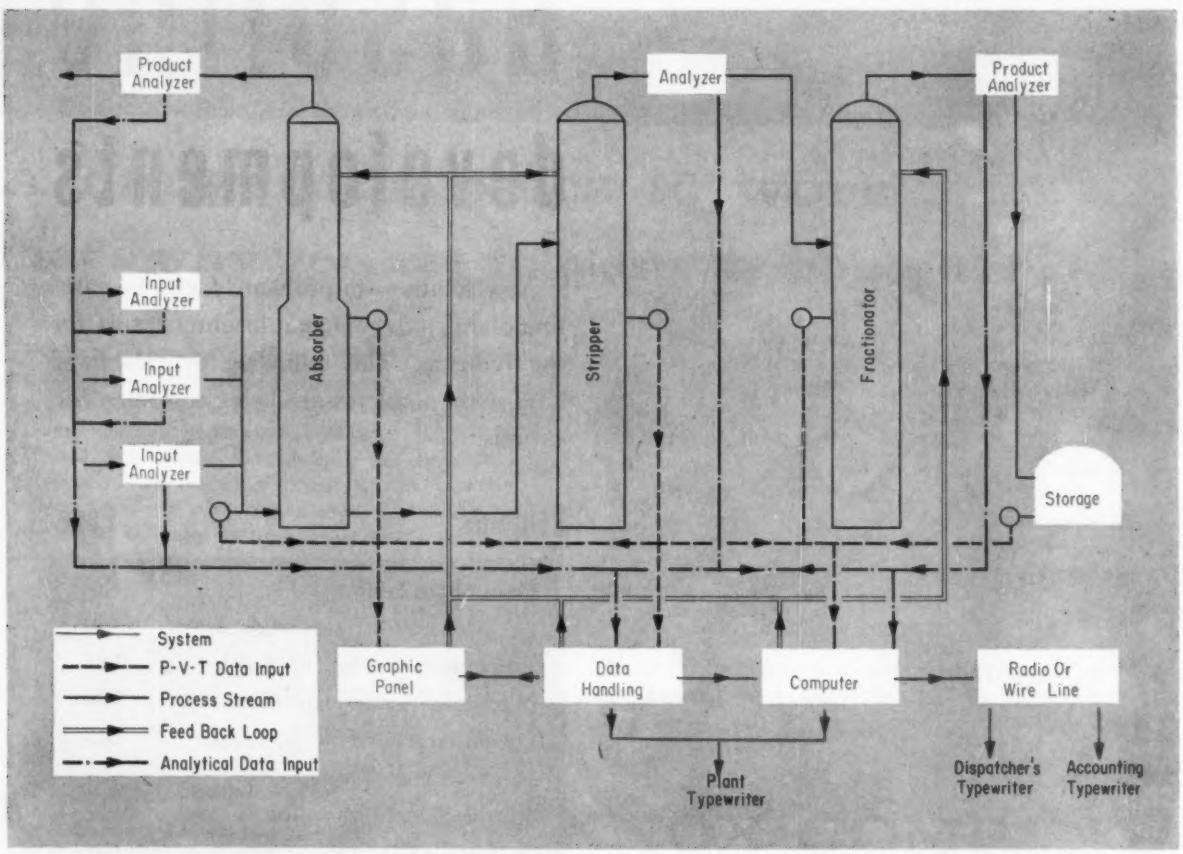

FIGURE 1—Control system for gasoline plant of future. To add others to these three unit operations, system circuits would be multiplied and in parallel with ones shown.

Gasoline Plant of 1975

Changing Product Demands. Changes in the technology of natural gasoline production will certainly be brought about by economic considerations—how to secure a greater dollar return on the feed stock being processed? The natural gasoline plant will become more closely allied with the rapidly growing petrochemical industry[1, 2, 45] and hence will be required to furnish products which are especially useful as raw materials for that industry. By 1965 the petrochemical industry is expected to supply 50 percent of chemical needs, whereas 35 years ago it supplied none. The 1965 demand will be practically twice as great as that of the present time.

There will be a greater demand for pure hydrocarbon compounds, e.g., ethane, propane, both normal and isobutane as well as those of higher molecular weight.[3, 4] An interesting new development is the tendency of field plant operators to enter the petrochemical field, such as has recently been the case with the production of butadiene as a raw material for synthetic rubber.[5]

In the interest of upgrading motor fuels there is already a trend toward the adoption of some of the processes utilized in refineries whereby reforming operations and hydroforming techniques are applied to natural gasoline fractions to bring about higher octane ratings in these products. Catforming and Platforming have already been applied in at least two such cases.[6] Process-wise, the natural gasoline plant will approach the greater complexity of the crude oil refinery.

For economic reasons, small gasoline plants with limited facilities will not be amenable to the complete application of these new developments. There will be a tendency to consolidate small operations into larger ones operating from multiple feed stocks on a joint basis.[6] When the feed stocks are quite different in chemical composition and quantity, the use of more precise and versatile control systems will be a necessity. Such systems will be required to furnish inventory and accounting data as well as to direct the operations of the plant. The former type of data will become very important to the unitized or joint operations of the future.

Process Development. In order to satisfy the demand for close cuts or pure compounds which are to be produced, it will be required that fractionation be improved to a marked degree. Improvements such as "superfractionators"[7] will find their way into the design of the plant of the future. In some cases it may not be possible or economical to achieve the separations desired by ordinary fractionation or distillation operations. It is to be expected that differential adsorption techniques such as the use of molecular sieves[8, 9] will become a part of the gasoline plant process.

This method has great promise for the separation of straight chain aliphatic from cyclic or branched chain compounds, e.g., normal heptane from methylcyclohexane. Operations such as chemical methods of separation, liquid-liquid extraction and many others will probably be used but they will not appreciably alter the general nature of the future control scheme.

Specific Sensing Required. Traditionally, gasoline plants have had their control systems based essentially upon the detection, measurement, recording and controlling of pressure, temperature, flow rate and volume, which are all physical properties of the process. Control of chemical composition is thus accomplished indirectly. Basically, this is a "P-V-T," or pressure, volume, temperature concept of control of process variables.

In order that more effective control be secured for the plant of the future it will be necessary to utilize "specific sensing" means to relate the control system to the chemical properties of the streams flowing within

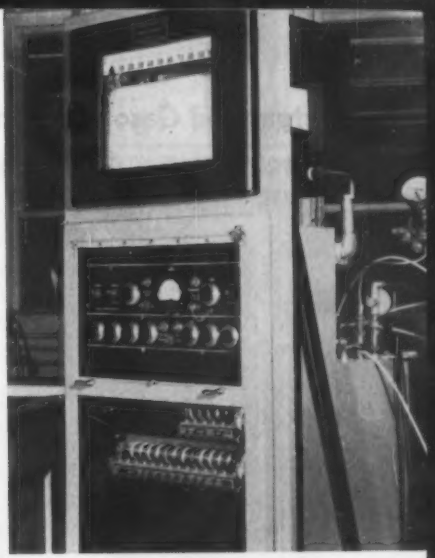

FIGURE 2—Continuous process stream chromatograph: The most attractive method for specific sensing.

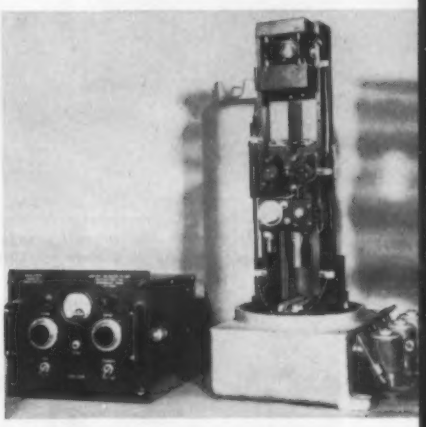

FIGURE 3—Continuous process stream differential infrared analyzer: Explosion-proof housing is removed.

FIGURE 4—Process monitor mass spectrometer for multi-stream and multi-component automatic analysis: It's being used to monitor gases from oil wells to permit closer control of underground combustion.

FIGURE 5—Process refractometer designed to continuously monitor the refractive index of liquid process streams: It's okay for Class I, Group C locations.

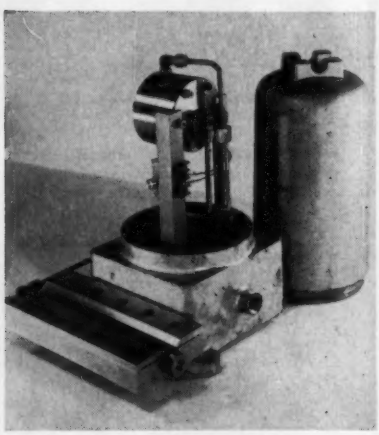

FIGURE 6—Continuous process stream electrolytic hygrometer with explosion-proof housing removed.

the plant. Here, the term "specific sensing" is meant to imply the use of a property or phenomenon which is peculiar or specific to the presence or concentration of a discrete chemical compound. The term will also be used later in a more general sense to imply the direct sensing of any property.

For example, a direct reading mass flowmeter is a specific sensing means whereas an orifice type meter is not. Direct sensing, measuring and controlling of the chemical composition will afford not only an opportunity for more precise control, but will lay the foundation for the application of logical control systems including data logging and read-out devices, as well as computers which will serve in a variety of ways as will be shown later.

Conversion of control systems to the ultimate of the future will not be abrupt. The present day concept of the centralized instrument board and graphic panel will be retained for a long time. In fact, it will still be the focal point from which all physical data will be drawn into the more sophisticated system of the future. The graphic panel, in a very small, miniaturized form, will still serve to furnish the operator with his mental picture of the operation. Greatly condensed graphic displays will be possible through the adoption of miniature components and the use of transistors in electronic circuits. Transition to the automated system of the future will be a slow evolution, consistent with the ability of the industry to absorb the new techniques and concepts. As this development progresses, some of the conventional instruments will be displaced by elements of the new system which perform the function more directly and at less cost. Direct transmission of electrical signals from transducers, for pressure, temperature, flow, chemical properties and other variables will permit bypassing pneumatic transmission systems and board mounted instruments.

These signals may go directly to data loggers or computers. Development of a variety of transducers for military purposes has been extensive.[47,48] The present trend toward acceptance of electric transmission systems will be accelerated through the use of transistors and miniaturized components which permit the use of low power at very low voltage.

Continuous Stream Analyzers. Stream analysis is now being developed at a rapid rate.[10,11,12] A variety of instruments have now been transformed from manually operated laboratory apparatus to automatic stream analyzers. These make possible the installation of equipment directly in the plant where samples are fed automatically to the analyzer or where the analyzer monitors a stream continuously without the necessity for taking discrete samples.

All of these stream analyzers have the property that they sense and measure a property of the stream which is related directly to the chemical composition of the stream. Notable among these are:

Gas Phase Chromatographs
Infrared Analyzers
Ultraviolet Analyzers
Continuous Differential Refractometers
Mass Spectrometers
Electrolytic Hygrometers

There are many other techniques under intensive development at the present time which have possible application in this field.

• **Gas chromatography** is probably the most attractive method in the above list, since it offers a relatively simple apparatus having the advantage of low cost and the distinct attribute that it can be utilized to measure a wide range of compounds of differing molecular weight and chemical structure in the same stream. Practically all of the compounds present in natural gas can be measured by this technique. The former disadvantage that this was a laboratory instrument requiring that discrete samples be fed manually to its input is now being rapidly overcome.

"In-plant" types of instruments with automatic sample injection have already been developed[13,14,15] so that the instrument can now be installed as a semi-continuous monitoring apparatus (Figure 2). When coupled with a suitable computer and read-out system, this equipment will be capable of numerically displaying the chemical analyses of streams to which it is adapted.

• **Infrared analyzers** (Figure 3) are another versatile continuous stream analyzer which will provide continuous and automatic composition analyses. Two types of these, namely, dispersive and non-dispersive, have been applied to continuous process control.[16,17] For reasons of cost the latter will have the greatest application in plant control. They may be used on either gas or liquid streams.[18]

• **Ultraviolet analyzers** will be most suitable for use in streams containing unsaturated and aromatic hydrocarbons and will therefore appear in the secondary processes associated with natural gasoline plants.[5]

• **Mass spectrometers** (Figure 4) are probably the most versatile of all instruments with respect to the diversity of chemical compounds which they will handle. Their use will no doubt be limited by their relatively high cost and complexity. However, for complex streams and problems justifying the cost, they will have definite use.[19] These continuous instruments have been employed in deethanizer overhead gas streams as well as for the analysis of pentane in debutanized products.[51]

• **Differential refractometers** (Figure 5) have special use in transparent liquid streams, particularly in the case of binary mixtures. Control of the fractionation of cyclo- and normal hexanes is an example.[10,20]

• **Electrolytic hygrometers** have been developed for continuous stream analysis of water content (Figure 6).[46] Such instruments will serve to monitor residue gas streams and supply data to control dehydration units automatically.

It may be anticipated that the application of these specific sensing instruments to gasoline plant processes will be one of the first steps taken toward greater automation of this type of plant. In fact, this development is necessary before the advantages of other adjuncts to the instrument system can be realized.

Automatic Data Handling and Logging. After the application of stream analyzers has been established, one of the next phases of development should be the use of data logging and read-out equipment to centralize the accumulation of data and the display of this information in numerical form for ready reference. Such equipment is already in a high state of development (Figure 7) and has been applied in some cases to refinery operations and many chemical plant processes.[21,50]

In addition to the data originating with new equipment such as stream analyzers, the data handling and logging equipment will process much of the conventional operating data such as pressure, temperature, flow rate and liquid levels. Signals from the control board and graphic panel will be converted from analog to digital form by suitable "digitizers." Frequently, the latter function will be a part of the data logger itself.[50]

Data logging consists primarily of feeding electrical signals to suitable digitizing and read-out equipment.[22] Usually the read-out equipment is an electric typewriter which automatically displays the information which the operator desires to study. This is essentially the same function which is accomplished by the operator when he manually reads an instrument on the control board and writes the numerical result on the log sheet. In effect, he is converting the "analog" output of the instrument to "digital" form. By placing suitable limiting instructions in the equipment it may be made to automatically indicate when operating conditions have gone out of bounds and therefore the operator should be warned or alerted.

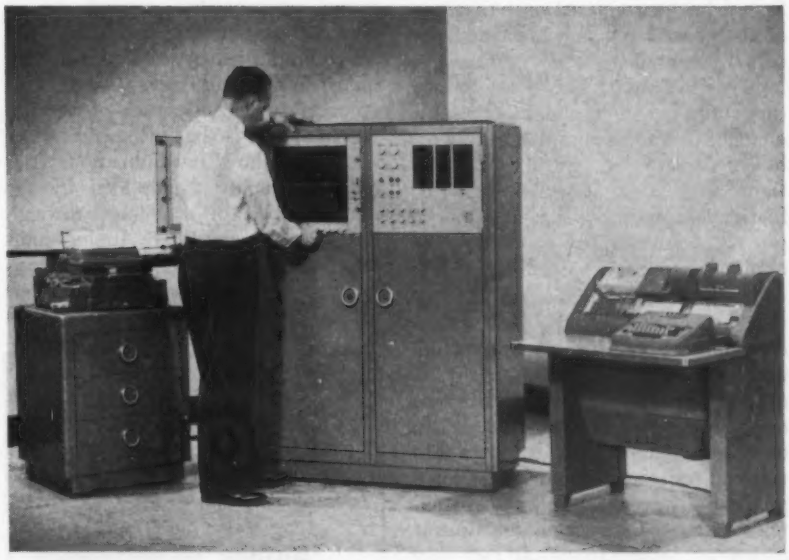

FIGURE 7—Data handling and logging equipment: Read-out typewriter at left.

In addition to the usual alarms, this is done by causing the typewriter to print the numerical data in red when conditions are outside the desired limits. Printing is done in black when conditions are within limits. More recent developments[23] tend toward the type of operation where printing is only done continuously when conditions are out of the normal range. Printing is accomplished only at periodic intervals, for recording purposes, when conditions are normal.

Data loggers will also be utilized as the transfer means by which information is sent to destinations other than the plant control room. For example, information which may be of interest to dispatchers will be telemetered from the control room to the dispatcher's office where an additional electric typewriter will display it for the information of the dispatcher.[28] Similarly, information which is of interest elsewhere, such as in a central office, will be telemetered to that office and displayed on separate machines where it can be useful to administrative personnel.

Another very important development in the speeding up of communications and improving the economics of operation of a plant is the use of the data logging equipment to telemeter accounting information such as inventory data, rates of production, rates of shipping, destination of shipments and similar accounting data to central accounting offices where it becomes immediately useful without awaiting the transfer of such information on paper. In unitized or joint operations such rapid recording and transfer of accounting data will be essential.

Data logging equipment frequently is referred to as being in the category of computers. However, for the purposes of this discussion data logging is considered to be distinct from computing, and the equipment involved is considered to be separate and to serve different purposes. In some data logging operations computing steps are carried out, but usually these are simple in nature and do not really involve the basic concept of

computing. Fundamentally, data logging involves only the conversion of signals from the plant to digitized information which is consistent with the signal and which may be displayed by a read-out device such as an electric typewriter.

Computers—Brain System. Thus far we have considered only that part of the control system which might be called, by analogy, the "nervous system" of the plant. This is the part of the control system which will sense changes in variables and transmit the information to a central accumulation center where it will be prepared for display, telemetering, and for input to the subsequent computing operation.

The computer, by analogy, will be the "brain" of the control system. In its electronic circuitry, actual calculations and mathematical procedures are carried out. Thus it does a type of "thinking" in the sense that it can carry out mathematical computations and can proceed through a prescribed program in accordance with instructions given to it prior to the time it makes its computations. It can only "think" in terms of its instructions and its programming, but can not "reason" or develop any instructions other than those which are fed into its input.

For those who wish to make a more detailed study of the subject of computers, there is already a vast store of literature which will be helpful to the layman in this field.[24, 25, 26, 27, 43, 54] A bibliography selected with special reference to process industries such as petroleum and chemical industries is contained in a recent article.[28] Some investigators believe that before 1965 computers will be running plants, with the subject having already been highly developed at that time.[29] Simplified presentations of the application of computers to the petroleum industry are becoming quite common.[30, 31, 44]

• **Analog.** Electronic computers are generally classifiable into two categories, depending upon the basic nature of the methods by which they make their computations. One of these is known as the analog computer.[32, 54] Although this type of computer is not expected to become the central computer of the natural gasoline plant, it bears brief discussion in order to contrast its operation with that of the digital computer which is expected to have a more extensive use as the central computing system.

Analog computers utilize natural processes to simulate the mathematical operation which it is desired to carry out. For example, analogies of many computations carried out in chemical engineering procedures can be accomplished by an electrical simulator which utilizes Ohm's law. Another typical operation of an analog computer is that of amplification, which simulates multiplication. It is most commonly exemplified by the multiplication of a voltage through an electronic amplifier. Analog computers are essentially simulators which carry out their computations utilizing the analogous system which may be set up in the form of an electrical circuit or a mechanical system which can be made to function to achieve the mathematical procedure desired.

These computers will have their place in simplified form to accomplish special calculations in certain portions of the plant system and to operate in short, localized closed loops. For example, flash calculations which are normally made to determine the composition and quantity of a vapor flashing from a liquid as the pressure is reduced may be simulated very nicely with an analog computer which involves Ohm's law as the analogy.

When the central plant computer does not have the capacity to handle certain special computations or if it becomes undesirable to include them in the central computer for any reason such as cost or the undesirability of complicating the central computing system, it will be possible to locate specialized analog computers either in the central system or at local stations closer to the sensing and analyzing apparatus.

Analog computers have one limiting characteristic, which also makes it an undesirable approach to the central computer problem. A high degree of accuracy is not possible with this type of computer, since it is inherent that the accuracy is limited by the physical characteristics of its components.

• **Digital.** By contrast, the digital computer is much more versatile and can be made to have almost any desired degree of accuracy, depending upon the complexity which is permissible. Digital computers actually represent numbers[43] and calculate in terms of digits and "yes" and "no" results which are expressed in terms of the figure *1* or the figure *0*.

A simplified explanation of the contrast between analog and digital computers is to describe the former as being somewhat related to a graphic or picture method of solving mathematical equations, whereas the latter deals with the numbers themselves and therefore can be designed to handle any arrangement of numbers just as would be the case with a desk calculating machine.[26, 30, 43, 54]

It is a common misconception that digital computers are extremely large and complex devices which have their place only in large scale re-

About the Author

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search operations. This is partially due to the publicity given recent installations.[33] Small digital computers have been developed[43] which, although limited in capacity and performance by comparison with the large general purpose computers, still have sufficient capacity and other characteristics to serve as the central "brain" for process control systems.[34, 52]

Experience gained in military electronics, particularly with airborne computers (Figure 8) has resulted in the development of compact and very useful computers. Miniaturization has been accomplished through the use of transistors, very small components and printed circuits (Figure 8). Manufacturers are now converting these units to process control computers (Figure 9) which are small in size, rugged, reliable, and have high capacity for their small size.[52, 53]

A digital computer consists of five general sections:

Input
Memory (storage)
Arithmetic Unit
Control
Output

The relationship of these is illustrated in Figure 10. Input data, after being processed by the arithmetic unit, can be stored indefinitely in the memory or storage unit. In high speed units this usually consists of a magnetic drum, cathode ray tubes or other devices capable of storing electrical signals. Some computers contain more than one type of storage. When it is a part of its instructions to do so, the computer may recall from storage any of the information which is contained therein. After performing the mathematical computations in accordance with the instructions, the computer can then feed information to the output.

The output is capable of displaying this information on an electric typewriter or any other suitable recorder. On the other hand, the output information may be fed in the form of electrical signals to any other apparatus and hence may be directed to closed loop control systems where it is fed back into the plant control to actuate control devices or to perform a wide variety of operations related to process control.

The speed of electronic computers is fabulously high compared with that which may be achieved by desk calculators. This permits these instruments to accomplish results which were not formerly possible with any manual procedure in a reasonable length of time. The average desk calculator with a human operator might be expected to accomplish about 400 ten by ten decimal digit multiplications in an eight-hour day. Digital computers of intermediate size can be made to accomplish this number of multiplications in one second, and can retain several thousand words of ten digits each in their memories.

• **Process Computers.** The computer which serves as the central "brain" of the control system will

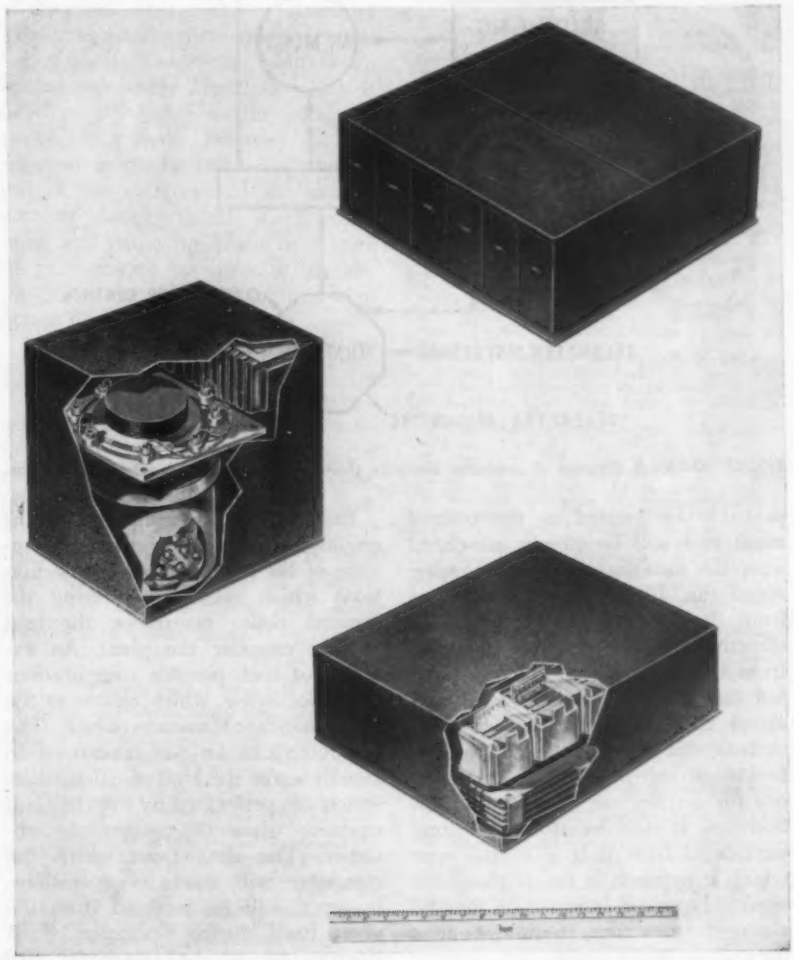

FIGURE 8—Computers are not always large. This airborne computer shows: Arithmetic unit with transistorized printed circuit inserts (lower right), magnetic drum and associated electronic equipment (center left); and input and output sections (upper right).

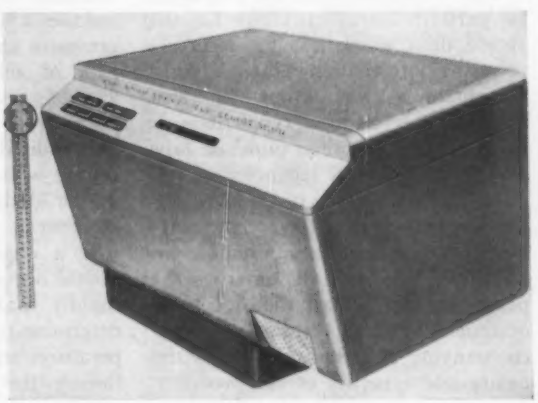

FIGURE 9—Compact computer for process applications: All three units of Figure 8 are housed in one cabinet.

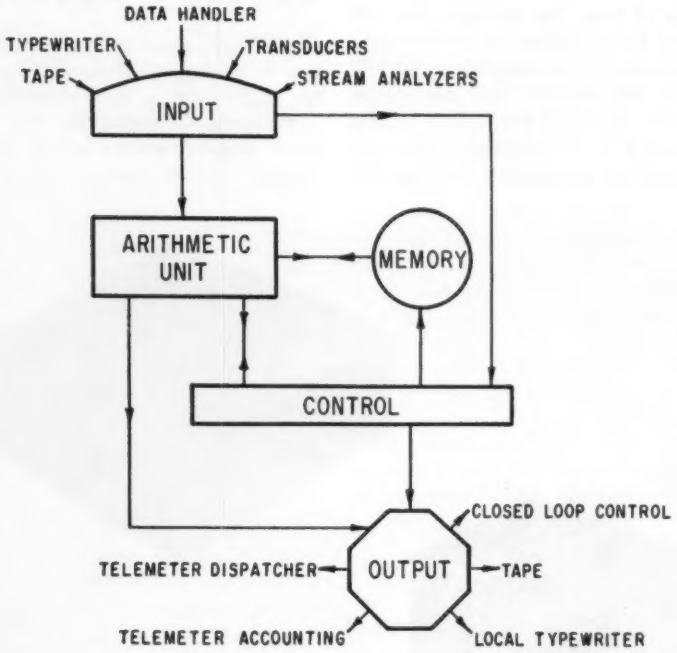

FIGURE 10—Block diagram of computer elements shows typical input and output information.

probably be located in the control room and will be closely associated with the data handling and logging apparatus. It will receive its input from the data handling equipment, directly from transducer circuits and from the instructions which will be fed into its input manually through an electric typewriter, punched tape, or magnetic tape. Certain of this information will be stored in its memory for further use in computations. Some of it may be stored for long periods of time if it is of the type which is required in future computations. The stored information may be changed from time to time as new data arrive at the input.

The computer may be instructed to perform computations on the stored data which will result in accounting information which is withdrawn through the output and transmitted either to local typewriters or to remote typewriters, punched tape or cards through a telemetering system. This will be one of the most important functions of the computer, to keep track of the quantities and composition of materials entering the plant and the distribution of these materials in the products with accompanying information as to the purity and quantity of the products.

In addition, the computer will be employed to optimize the performance of the plant by making calculations which relate to securing the greatest dollar return on the feed streams entering the plant. An example of such possible computations is the following, which relates to the performance of an absorber. The computer can be programmed to rapidly make the kind of calculations which are performed by the chemical engineer when he designs the absorber. The data from which the computer will start its operations, however, will be received from the plant itself during operation. Such information as the quantities and analyses of the inlet stream, the residue gas, the temperatures and pressures existing in the system, the rate of oil circulation, and other variables can be taken by the computer from its input or its memory and utilized in a mathematical procedure which is very much the same as the method used in designing the absorber.

If a change in feed composition should occur, the computer can very rapidly make the computation and determine the optimum oil rate, temperatures and other factors which influence the performance of the absorber. By feeding the output of the computer back into a closed loop in the control system it is then possible to optimize the performance of the absorber in terms of the best economics for the feed stream being processed. The mathematical basis for computer calculations in the design of multicomponent absorption towers has been set forth by investigators in this field.[35]

Similarly, the computer can be programmed to handle calculations which will optimize the performance of such fractionation systems as those already discussed, involving the use of adsorption techniques such as molecular sieves.[8,9] Mathematical procedures for digital computers have also been developed for similar techniques.[36]

Other operations involved in the natural gasoline plant can likewise be optimized with respect to their economic performance. One of the most important of these is distillation and fractionation, which has also been the subject of computer calculations.[37]

Integrated Control System. Consideration can now be given to the complete control system of the plant of the future. The three categories of equipment discussed above, namely, continuous stream analyzers, data handling and logging equipment, and computers, will be combined in the manner shown in Figure 1. The primary data for the control system will be taken from the streams flowing into and within the plant from the continuous analyzers and from the conventional physical data system which will provide temperature, pressure, and flow data.

This information will be fed to the input of the data handling and logging system, which will prepare it for display for the benefit of operators who will be provided with instantaneous information as it is read out on the electric typewriter or other display equipment such as recorders. The data logging apparatus may also prepare punched tape which will serve as the input to read-out equipment or simultaneously as input information to the computer.

Input information from the computer may also be drawn directly from the output of the data logger without passing through the intermediate step of being recorded on punched tape. The computer will

store the information in its memory in accordance with its instructions and will perform the computations which have been set up in its program.

The results of these computations may also be displayed on an electric typewriter or may be transmitted by telemetering techniques over wire lines or by microwave radio to remote locations such as the central accounting office or to dispatchers' typewriters. Also, the output of the computer may be fed back into a closed loop system which will actuate controllers so that they can be reset in a manner to optimize the performance of equipment in the plant.

Cost Justified. There has been considerable controversy as to the feasibility of employing the rather complex type of instrument system described here because of its probable high cost and therefore its burden upon the capital investment of the plant. However, studies which have been made in the recent past[38,39] indicate that this additional cost for instrumentation will be justified because of the following benefits.

- Optimum balance of performance and cost.
- Greater throughput because of more continuous operation at high levels of efficiency.
- Elimination of some of the components of conventional instrumentation.
- Elimination of some of the process steps.
- Reduction of cost and acceleration of transmission of accounting data, dispatching data and other information which is important to the management of the plant.

In addition to the functions of the control system which have been considered above, there are other possibilities for combining information from the field and gathering system which will be briefly mentioned. One of these is the possibility for integrating data collected at individual leases through the medium of automatic custody transfer.[40,41] Such information, when fed to the computer, could be combined with the accounting data which will be in its output, to show the distribution of feed stocks over the individual leases and to indicate the distribution of the materials from the leases in the products of the plant. This rapidly developing field of automatic custody transfer is not only progressing in a practical way through the application of instrumentation to lease equipment, but is being considered favorably as a standard procedure for custody transfer by such organizations as the API.[40]

Another interesting possibility is the combination of a reservoir behavior analyzer[42] with the computing system of the plant. This analyzer, sometimes known as an electrical reservoir analog, usually takes the form of an analog computer. The data which it develops pertaining to the most desirable long term behavior of the reservoir might be utilized in the input of the computer of the natural gasoline plant to modify its programming and cause the plant to change its performance to optimize the depletion of the reservoir for best economic return.

Process studies which are being made on separate computers by engineers located at remote offices will utilize plant operating data, telemetered to the remote office from the data logger output or the plant computer. Interesting results have been obtained from the application of this technique to the telemetering of data from an operating unit in Niagara Falls, N. Y., over wire lines to a computer in Philadelphia.[49]

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To Get Along With Your Producer—Try These Rules

G. W. McCullough
Phillips Petroleum Company
Bartlesville

WHEN YOU GET right down to it, natural gasoline operators are the middlemen between the producer and the customer. It was once the predominant purpose of natural gasoline plants to make a profit for the owners. The profit interest is still there but we have come to see that service is a requisite of profit making. Service to the customer is well recognized; now we must apply it also to the producer who supplies us with the raw materials to produce natural gasoline products.

Here are five rules that secure better producer relations:

1. **Make Economic Studies Promptly.** The producer develops his leases for the sole purpose of producing oil and gas. As soon as oil and gas production starts, he wants to put both his oil and his gas in the market and to realize a return on his investments. Any unnecessary delay in selling costs him money. This means that we, as natural gasoline plant operators, must keep up daily with the status of every well being drilled adjacent to our plants. On completion, we must quickly complete our engineering and economic studies of ways and costs to gather and process this gas as well as make necessary contracts for its purchase. We must provide a reasonable amount of pipe, compressors, and auxiliaries to make early tie-in possible. Analysis of nonprofitable gas should be the occasion for conference with the producer to allow consideration of further ways and means of disposal.

2. **Respect His Property.** Since the tieing in of his wells and the subsequent measurement of his gas necessitate a certain amount of travel across his property by various company employes, he is concerned with the protection of the property, fences, crops, livestock, and the general appearance of his owned or leased premises. Proper conduct of our employes respecting the producer and property owner is a requirement.

3. **Maintain Measurement Equipment.** The producer contracts the sale of his gas under contracts having fairly uniform terms and conditions industry-wide in practice. He is paid for his gas on the basis of content tests and the volume delivered. Thus he is vitally concerned with the accuracy of the tests and of our measurement equipment. Installation and maintenance of standardized testing and measurement equipment is an industry obligation but as plant operators, a day to day problem.

4. **Explain Your Pay Scale.** The computation of the price paid him for his gas is sometimes complex and confusing to the producer, and his inquiry for explanation should be referred to company representatives who are fully conversant with the testing and measurement equipment and the accounting procedures for settlement.

5. **Answer His Complaints Promptly.** Complaints by the producer and requests for information or assistance, if not answered promptly can become a source of irritation. Designation of specific responsibilities to definite individuals allows for minimum buck-passing, more expedient handling and should improve our producer relationship.

With these rules, we can now devise a program that will be of service to the producer. Of what would such a program consist? It should be comprised of three separate phases.

The first phase would include the *procedural problems.*

Included would be all company procedures which affect the producer; such as procedures for following the development of leases and the production of gas; procedures for negotiating gas contracts; procedures for tieing in wells, etc. All our contracts, settlements, and day to day operation procedures should be carefully scrutinized with the objective of making any revisions that would improve our services to him.

The second phase would cover the *training of all employes* who contact the producer or who enter upon his owned or leased property. Its purpose would be to instruct them in the performance of their assigned duties to the end that each represents the company in a manner which will create a strong bond of friendship with the producer.

The third phase would cover *communications with the producer.* Its purpose would be to keep the producer advised of incidents that affect his operations such as plant shutdowns, pipe line breaks, delays in plant start-up, and similar occurrences. It would also include discussions with the producer on company problems such as the importance of smooth gas flow to plant efficiency and the resulting effect on the producer's income. The better understanding the producer has of company problems, the more tolerant he will be of our efforts to cooperate in correcting both his problems and ours.

This material is condensed from a presentation before the NGAA, Amarillo, November 30, 1956. ##

About the Author

G. W. McCULLOUGH received his B.S. degree in mechanical engineering from Oklahoma A&M in 1925. He eventually became vice president and chairman of the operating committee of Phillips Petroleum; vice president and member of the board of directors and executive committee of Phillips Chemical and Phillips Terminal Companies. Recently he was made manager of the Natural Gasoline department of Phillips Petroleum.

Adsorption—The Process to Watch

W. M. Dow, Parks and Dow, Houston

Here's one fixed-bed unit recently developed to recover natural gasoline from small volume, lean gas streams.

THERE IS A NEED in the natural gas and refinery industries for an economic and efficient hydrocarbon recovery unit to extract raw gasoline from relatively small natural gas streams. The two primary processes, oil absorption and refrigeration, for gasoline recovery from natural gas streams in commercial use today are not practical nor economical for processing relatively small (5 to 15 MMcf/d and lean (0.100 to 0.300 gpm) streams.

It appears that this need might well be filled by packaged adsorption units which utilize fixed beds of silica gel or activated charcoal to recover raw gasoline components from the natural gas stream. An example of such an adsorption unit has been developed and tested. Although the unit was developed to extract raw gasoline from relatively small and lean natural gas streams, it is also applicable to rich gas streams and appears to be capable of being developed into a large, central processing plant to recover multiple liquid products.

How the Unit Works. Figure 1 is a photograph of a packaged and skid-mounted processing assembly which has been developed to extract and recover hydrocarbon liquid fractions from a natural gas stream by adsorption. This particular unit is capable of recovering about 40 barrels per day of stable, lease-tank raw gasoline from a natural gas stream. It has been designed to operate under usual gas pipe line conditions, about 80 F. and up to 1200 psi.

The basic process assembly of the adsorption unit is capable of recovering lighter hydrocarbons, such as propane and butane, as well as the gasoline fractions. However, the illustrated unit has been developed specifically to recover only stable, lease-tank products. Additional liquid separation and storage equipment would be necessary in order to recover multiple liquid products. The presently developed processing equipment is not capable of recovering such additional products.

The adsorption unit is fully automatic, self-contained and skid-mounted. No external cooling or heating medium, such as water or steam, is needed. Utility requirements are minor. Fuel gas requirements are equivalent to about 8 cents per barrel of recovered product, while electric power requirements to drive

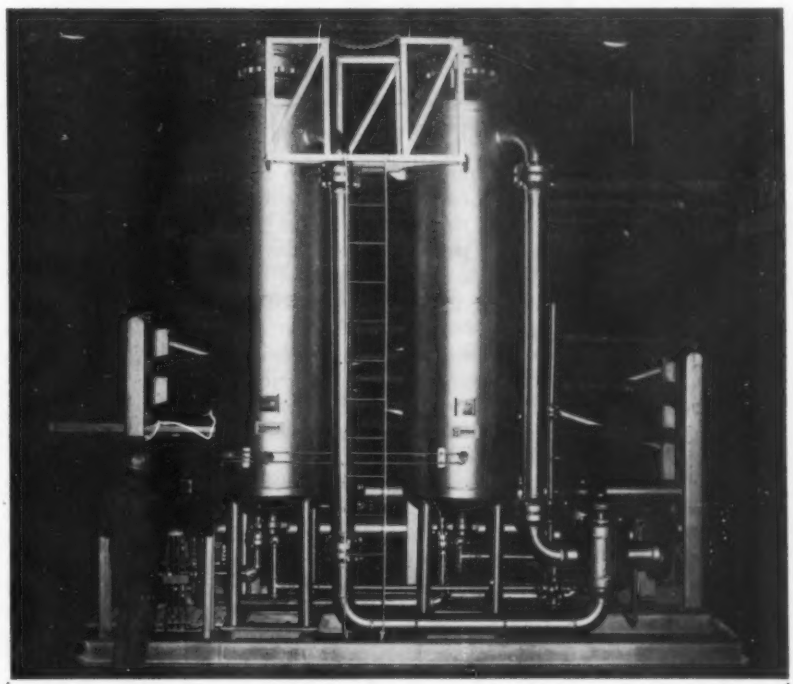

FIGURE 1—Packaged and skid-mounted adsorption unit: It can recover 40 bpd of stable, lease-tank raw gasoline.

TABLE 1

A 40 BPD Unit Shows This Attractive Payout:

Cost of adsorption unit	$40,000
Installation cost	4,000
TOTAL INSTALLED COST	$44,000
DIRECT EXPENSES (fuel gas, electricity and one adsorbent change)	$ 3,700/yr.
REVENUE (@ $3.20/bbl & 355 days)	$45,400/yr.

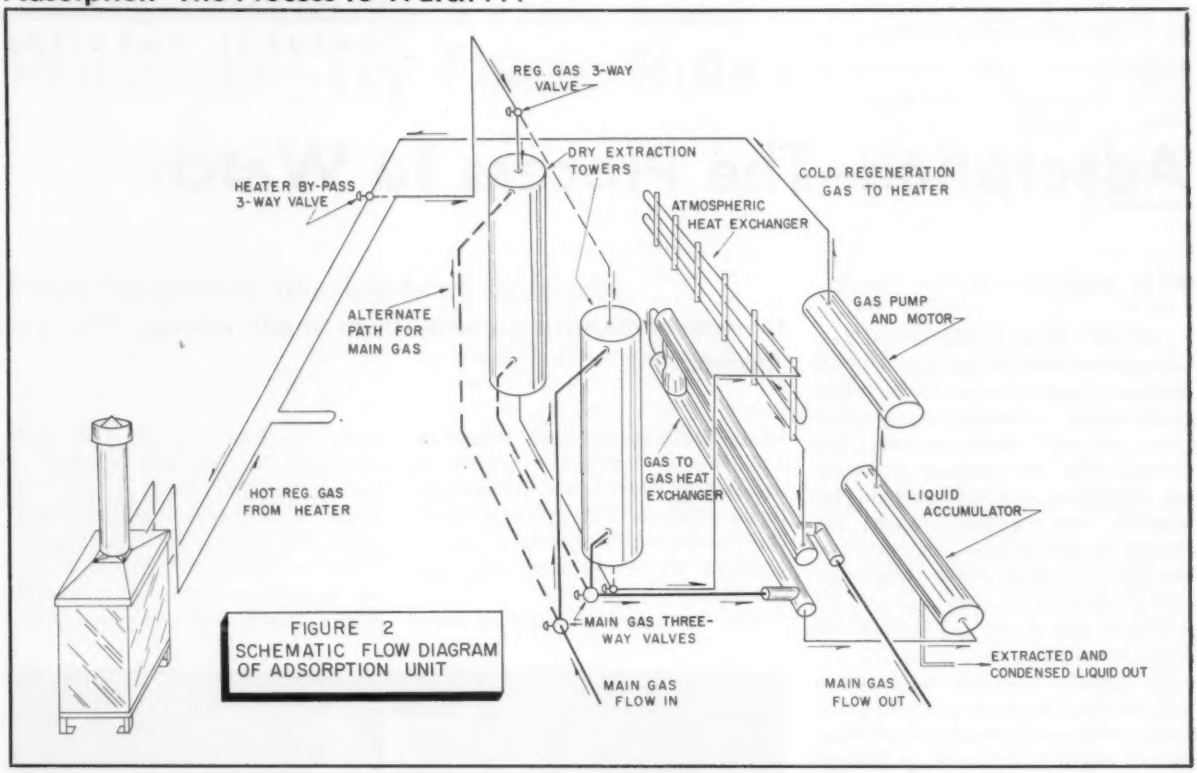
REG. GAS 3-WAY VALVE
DRY EXTRACTION TOWERS
COLD REGENERATION GAS TO HEATER
HEATER BY-PASS 3-WAY VALVE
ATMOSPHERIC HEAT EXCHANGER
GAS PUMP AND MOTOR
ALTERNATE PATH FOR MAIN GAS
GAS TO GAS HEAT EXCHANGER
LIQUID ACCUMULATOR
HOT REG. GAS FROM HEATER
MAIN GAS THREE-WAY VALVES
EXTRACTED AND CONDENSED LIQUID OUT
MAIN GAS FLOW IN
MAIN GAS FLOW OUT

FIGURE 2
SCHEMATIC FLOW DIAGRAM OF ADSORPTION UNIT

a small, 5-horsepower, gas pump are equivalent to about 7 cents per barrel of recovered product. Either three-phase or single-phase electric power may be used, or if desirable, an auxiliary power unit, such as a gasoline motor, may be used to drive the gas pump. The control system has been designed and engineered to give safe, reliable and automatic operation of an unattended unit. Only periodic observations of the operation of the unit and periodic inspections of the control system are needed.

As shown by Figure 2, the basic process is similar, in a general way, to conventional adsorption processes, i.e., two fixed beds of solid granular adsorbent material are used to continuously adsorb hydrocarbon fractions from the gas stream which is switched to flow through one bed and then the other, with the off-stream bed being reactivated by hot gas.

This particular processing assembly has been developed especially to give efficient adsorption and recovery of raw gasoline from natural gas streams and embodies numerous unique design features which are essential for such applications. The hydrocarbon extraction efficiency is very sensitive to the manner of adsorption, careful control of the heat balance during regeneration, and especially to the manner of condensing and recovering the extracted liquid from the hot regeneration gas stream. The developed unit is capable of achieving over 85 percent extraction and recovery efficiency of the pentanes plus in a natural gas stream.

Vessel and Control Assemby. The vessel assembly consists of essentially two vertical adsorption towers, a heat exchanger, an extracted-liquid accumulator vessel, a gas pump and motor, a direct fired gas heater, plus the associated gas piping and valves.

The gas flow controls consist of five three-way valves pneumatically actuated by a self-switching automatic control system. Two large three-way valves direct the flow of the main stream through one tower and then the other, while two small three-way valves direct the flow of the regeneration gas stream through the appropriate tower. The fifth three-way valve bypasses the regeneration flow around the heater during the cooling period of each cycle. Conventional liquid level controls and dump valves are used to discharge the recovered hydrocarbon liquids from the accumulator vessel to stage separators, or lease tanks.

The direct fired gas heater is fully automatic and has numerous safety controls. Safety check valves are installed in the regeneration gas line on each side of the heater to prevent gas venting to the atmosphere in the event of heating coil failure. A safety pilot burner insures safe on-off operation of the main burners and stops the flow of all fuel gas, for main burners and pilot burner, in the event of a pilot flame outage. Automatic controls prevent firing of the heater in the event of regeneration gas flow stoppage or electric power failure.

As shown in Figure 2, the main gas stream, which should be free of entrained liquid, flows down through an extraction tower, through the gas-to-gas heat exchanger and then out of the unit. The regeneration gas stream is circulated continuously by a motor-driven gas pump through the heater, tower, heat exchanger, and liquid accumulator. The heater is bypassed during the cooling period of each cycle. The three-way control

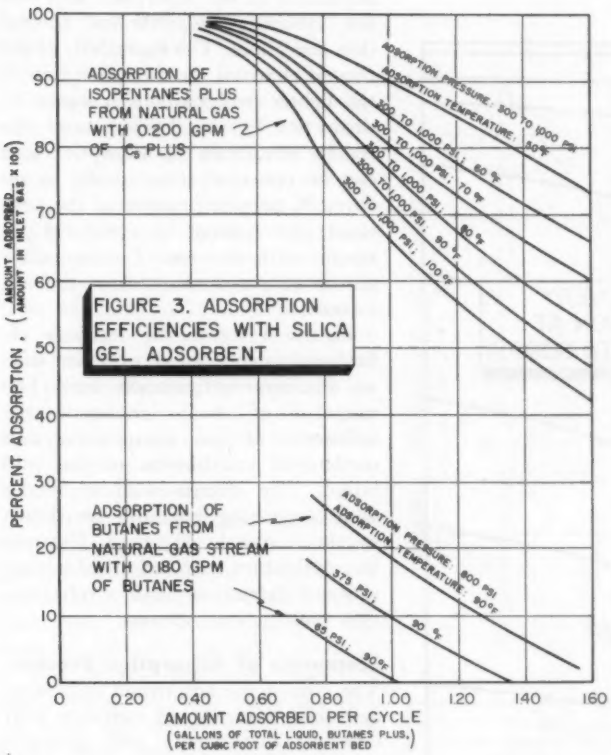
ADSORPTION OF ISOPENTANES PLUS FROM NATURAL GAS WITH 0.200 GPM OF C_5 PLUS
ADSORPTION PRESSURE, 300 TO 1000 PSI
ADSORPTION TEMPERATURE, 50°F
300 TO 1,000 PSI, 60 %
300 TO 1,000 PSI, 70 %
300 TO 1,000 PSI, 80 %
300 TO 1,000 PSI, 90 %
300 TO 1,000 PSI, 100 %
ADSORPTION OF BUTANES FROM NATURAL GAS STREAM WITH 0.180 GPM OF BUTANES
ADSORPTION PRESSURE, 800 PSI
ADSORPTION TEMPERATURE, 90°F
375 PSI, 90 %
85 PSI, 90%
PERCENT ADSORPTION, (AMOUNT ADSORBED / AMOUNT IN INLET GAS x 100)
AMOUNT ADSORBED PER CYCLE
(GALLONS OF TOTAL LIQUID, BUTANES PLUS, PER CUBIC FOOT OF ADSORBENT BED)

FIGURE 3. ADSORPTION EFFICIENCIES WITH SILICA GEL ADSORBENT

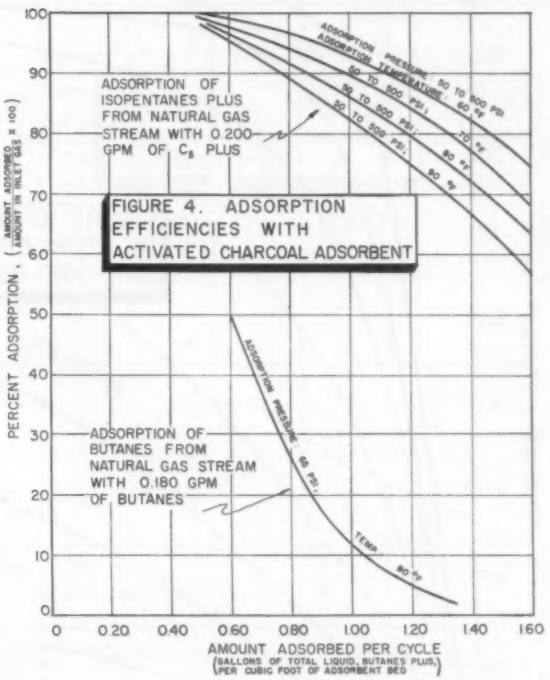
ADSORPTION OF ISOPENTANES PLUS FROM NATURAL GAS STREAM WITH 0.200 GPM OF C_5 PLUS
ADSORPTION PRESSURE, 50 TO 500 PSI
ADSORPTION TEMPERATURE, 60°F
50 TO 500 PSI, 60 %
50 TO 500 PSI, 70 %
50 TO 500 PSI, 80 %
50 TO 500 PSI, 90 %
ADSORPTION OF BUTANES FROM NATURAL GAS STREAM WITH 0.180 GPM OF BUTANES
ADSORPTION PRESSURE, 68 PSI
TEMP 90°F
PERCENT ADSORPTION, (AMOUNT ADSORBED / AMOUNT IN INLET GAS x 100)
AMOUNT ADSORBED PER CYCLE
(GALLONS OF TOTAL LIQUID, BUTANES PLUS, PER CUBIC FOOT OF ADSORBENT BED)

FIGURE 4. ADSORPTION EFFICIENCIES WITH ACTIVATED CHARCOAL ADSORBENT

valves determine which adsorption tower each gas stream will flow through. Normal operating cycles are 30 to 60 minutes.

Efficiency of Adsorption Process. The adsorption efficiency for the extraction of hydrocarbon liquid fractions from a natural gas stream is affected primarily by temperature and to a lesser degree by gas composition and by static pressure. The adsorption efficiency is, of course, a function of the type of granular desiccant which is used as well as the design and dynamic performance of the processing equipment.

The over-all recovery of any adsorption unit is not merely a function of the adsorption efficiency but is influenced greatly by the effectiveness of the condensation of the vaporized extracted hydrocarbons during the regeneration process. The efficiency of the condensation operation can be very sensitive to numerous factors, such as process flow design, material and heat balance design, composition of the enriched regeneration stream, and condensation temperature and pressure. The presently developed adsorption assembly can achieve 95-plus percent condensation of the adsorbed and vaporized hydrocarbons over a wide range of gas compositions, and condensation temperatures and pressures.

Silica gel and activated charcoal are the two most practical and efficient adsorbent materials to use in the adsorption unit. Activated charcoal has a slightly greater adsorption efficiency for gasoline components than silica gel, and is much superior for the recovery of the lighter hydrocarbons such as propane and butanes, especially at low operating pressures. However, silica gel has certain operational and economic advantages and is capable of dehydrating the gas stream while it is extracting the hydrocarbon liquid products.

Figure 3 shows the dynamic adsorption efficiencies of the presently developed processing assembly with a silica gel adsorbent operating under typical natural gas pipeline conditions of temperature, pressure and gas composition. Figure 4 gives the dynamic adsorption efficiencies of the unit with an activated charcoal adsorbent under similar operating conditions. The efficiencies shown in Figures 3 and 4 represent actual dynamic per-

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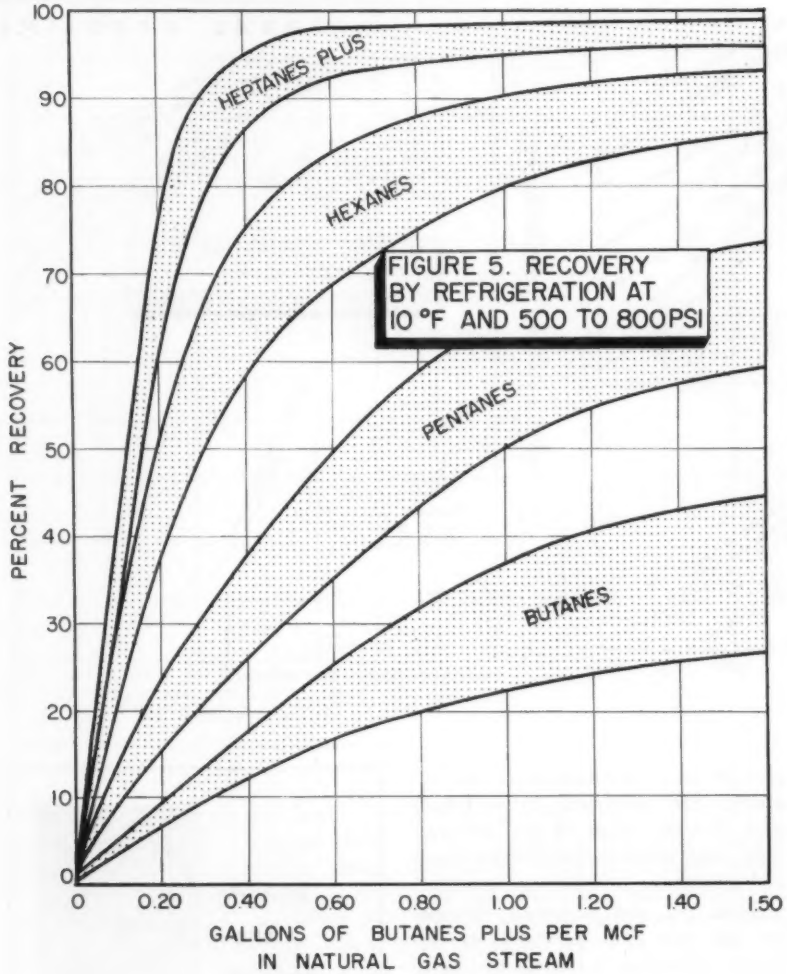


FIGURE 5. RECOVERY BY REFRIGERATION AT 10 °F AND 500 TO 800 PSI

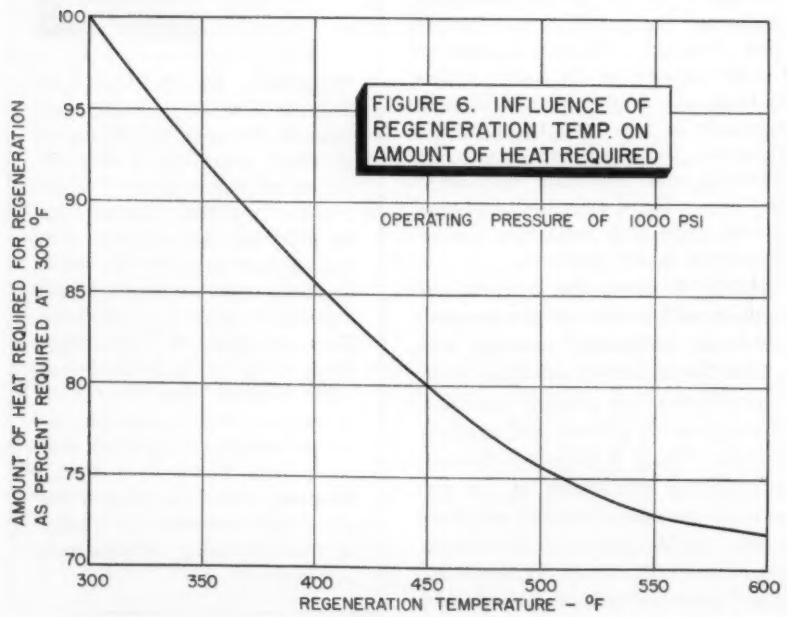


FIGURE 6. INFLUENCE OF REGENERATION TEMP. ON AMOUNT OF HEAT REQUIRED

formances of the adsorption unit and not laboratory equilibrium adsorption conditions. The superiority of activated charcoal for the adsorption of the lighter hydrocarbons is shown by these two figures. Under usual operating conditions the adsorption unit can be operated economically to recover 80 percent or more of the pentanes plus content of a natural gas stream with the use of either silica gel or activated charcoal as the adsorbent.

Figure 5 shows the recovery efficiencies which can be expected with an auxiliary refrigeration unit. The range of efficiencies represents the influences of gas composition and method of stabilization of the cold liquid. The decreases in recoveries with decreasing contents, as shown by the curves in Figure 5, illustrate the difficulties involved in obtaining efficient extractions with a refrigeration unit on lean streams.

Economics of Adsorption Process. The cost of the adsorption processing assembly, unitized and complete with controls, instruments and granular adsorbent, will vary from about $800 to $1400 per barrel of daily recovery of raw gasoline, for unit sizes varying from about 20 to 100 barrels per day recovery. The larger the unit the lower will be its unit cost. Installation costs, including cost of auxiliary equipment such as stage separators and storage tanks, will vary depending upon the conditions of each installation but, in general, will be about 5 to 15 percent of the cost of the processing assembly.

In addition to the relatively low initial cost, per barrel of daily product recovery, of the adsorption processing assembly a major economic advantage of the unit is its exceptionally low operating cost and simplicity of operation. The low operating costs for fuel and utilities for the adsorption unit may be illustrated by comparing such costs with comparable costs for large, efficient oil absorption plants.

Direct operating costs for fuel gas and electricity for small packaged adsorption units will amount to 15 cents or less per barrel of recovered product. Fuel costs will be about 8 cents per barrel of product, while electricity costs will be about 7 cents per barrel of product for small units capable of recovering from 20 to 100 barrels per day. The electricity costs

are high because high unit costs, from 3 to 4 cents per kwh, were assumed due to the exceptionally low electric load.

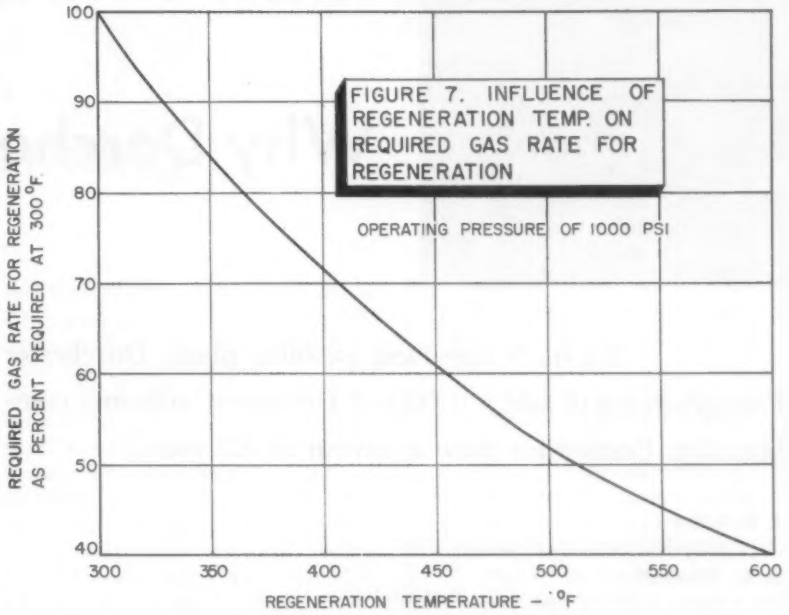
Comparable direct costs for large, efficient oil absorption plants which utilize low cost electricity, and cheap steam, water, and fuel are at least twice as great as the costs for the small adsorption units. Comparable steam, water, power and fuel costs for large oil absorption plants vary from about 25 to 35 cents per barrel of absorbed product. These utility costs are for the absorption end of the plant only, i.e., operation of absorbers and rich oil still, and do not include the utility costs for the separation end, i.e., deethanizer, depropanizer, etc., of the plant.

Utility costs for a small oil absorption plant would, of course, be much greater than the 25 to 35 cents per barrel range because of higher utility unit costs and low operating efficiencies. Likewise the utility costs for a very large adsorption processing plant would be considerably less than 15 cents per barrel because of the much lower unit cost for electricity.

The influence of regeneration temperature on the amount of heat required and rate of gas flow required to regenerate the adsorbent towers in the presently developed processing unit is shown in Figures 6 and 7. These curves show the economic advantages of utilizing a relatively high, 550 to 600 F., regeneration temperature. For example, a 28 percent fuel savings would be realized by regenerating at 600 F. rather than 300 F. and the gas flow requirements would be only 40 percent as great. Other operating advantages, such as more efficient condensation and longer absorbent life, are gained by the utilization of high regeneration temperatures. For these reasons the presently developed adsorption unit has been designed to utilize a 550 to 600 F. regeneration temperature.

Table 1 gives the economics of a typical adsorption processing installation with a recovery capacity of 40 barrels per day. This unit, for example, could be placed on any typical natural gas stream of 5 to 20 MMcf-/D with a pentanes plus content from about 0.35 to 0.09 gpm, respectively.

Even after generous allowances for maintenance and labor costs, the payout of such a unit appears very attractive. # #



How Adsorption Fits Into the Recovery Picture

THE TWO PRIMARY processes for gasoline recovery from natural gas streams in commercial use today are the oil absorption process and the low temperature refrigeration process. The oil absorption process has attained widespread commercial success in the form of large central gasoline plants with recovery capacities of several thousands of barrels per day of numerous liquid products. However, the economics of such a plant will not justify its use on small, relatively lean gas streams. Small portable-type oil absorption plants have not been successful commercially, except in a few special cases.

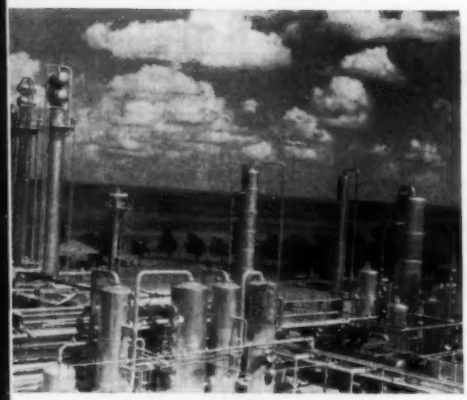
Low temperature refrigeration plants have achieved some success in treating small, isolated gas streams, but only when the gas stream is unusually rich in heavier hydrocarbon fractions. Most natural gas streams from presently produced gas wells contain only 0.100 to 0.300 gallons of pentanes plus per thousand cubic feet of gas, and such gas streams are much too lean for the commercially successful operation of a low temperature refrigeration plant.

In general, neither oil absorption plants nor low temperature refrigeration plants are practical or economical for processing the gas flow from one or a few gas wells. Relatively simple low-temperature-separation units, which can utilize the energy of high pressure flowing gas wells in place of an auxiliary refrigeration source, have found widespread use throughout the industry as an individual gas well installation. However, only a minor portion of the total producing gas wells have high enough flowing pressures to justify economically the installation of a low-temperature-separation unit. Even then, the amount of hydrocarbon recovery will decrease rapidly as the separator temperature increases with the natural decrease in flowing pressure of the well. Even though the low temperature units do a commendable job of recovering additional condensate under the proper operating conditions, they still leave a large amount, 30 to 70 percent depending upon operating conditions, of the raw gasoline in the residue gas stream.

Need to Treat Small Gas Streams. Of the total natural gas currently being produced in the U. S. only about 65 percent is undergoing processing for the recovery of gasoline and liquid hydrocarbon fractions. A large portion of the untreated gas consists of relatively small and lean natural gas streams which cannot be processed economically by means of conventional oil absorption or refrigeration plants. About 10,000 million cubic feet per day of untreated natural gas are currently being produced in the U. S.

There is a definite need, from an economic as well as conservation viewpoint, in the natural gas and refinery industries for an economic and efficient hydrocarbon recovery unit to extract raw gasoline from relatively small natural gas streams. There are thousands of small, 2 to 20 MMcf/d, natural gas streams each containing from 15 to 100 barrels per day of recoverable gasoline liquids which are not currently being processed.

This need might well be filled by packaged adsorption units.



a Special Report

NATURAL GASOLINE

Why Dorchester Will Add

To its White Deer gasoline plant, Dorchester Corporation will add a 1000 bpd Unifiner-Catformer combination. Economics show a payout of 1.3 years.

J. G. Eckel
Dorchester Corporation, Amarillo, Texas

G. R. Worrell
The Atlantic Refining Company, Philadelphia

DORCHESTER CORPORATION will complete the addition of a Unifiner-Catformer combination process in June at its White Deer (Texas) gasoline plant. Behind this move is what other gasoline plant owners are faced with: declining prices for higher boiling liquid products. Most have been reluctant to enter the motor gasoline business; they prefer instead to sell their product to refiners as a blend stock or as a raw material for chemicals.

Early Entry. Back in 1940 Dorchester Corporation of Amarillo, Texas, then operating as a partnership, was faced with the problem of making a profit when the price of 26-pound natural gasoline was only 1.5 cents per gallon. At that time propane and surplus butanes were marketed as LPG, and 26-pound natural was sold to a pipe line gathering system at the prevailing price. An expansion program was begun in the plant at White Deer and has been continuing ever since, leading finally to the decision to install a modern refining process.

The first step in the expansion was to install a butane splitter and sell isobutane for a premium price. The next step was to separate and market isopentane, which was just coming into demand. Then the pipe line gasoline contract was cancelled with the intention of selling deisopentanized natural to a local refinery, but this arrangement did not materialize. As a result the decision was made to go into the gasoline business and sell to farmers in the vicinity of the plant.

Before the gasoline was acceptable, the normal pentane content had to be reduced. An attractive market was ultimately found for normal pentane as a raw material for chemicals, but it was discovered that farm gasoline demand wouldn't support the company on a year-round basis. Additional fractionation was installed, and a TEL license was obtained. By the fall of 1941 regular gasoline of 72 motor octane number and premium of 80-plus motor octane were being marketed. These octanes were competitive at the time.

Competitive Until 1954. By increasing TEL content and using isopentane for vapor pressure blending the company stayed competitive until 1954. At that time they started purchasing catalytic cracked naphtha to use as a blend stock and maintain required octane levels. In July of 1954 the company, by then known as Panoma Corporation, was sold and the name changed to Dorchester Corporation. In spite of the traditional hesitation to install refining processes the favorable economics led to the decision to invest in catalytic reforming in the fall of 1956.

Grebe and Doremus Process Company has been contracted to design and build a Unifiner-Catformer combined process under license from The Atlantic Refining Company. Design capacity is 1000 barrels per day. The unit is scheduled for start-up at the White Deer plant in June.

Personnel of Dorchester Corporation and Atlantic thought it would be helpful to other natural gasoline operators if the economics of the proposed operation were published. Parallel situations undoubtedly exist

TABLE 1
Unifiner-Catformer Feed Stock Properties

Gravity, °API	68.1
Reid Vapor Pressure, PSIG	4.5
Aniline Point, F	134.5
Sulfur, weight percent	0.013
Research Octane, clear	57.0
Research Octane, 3cc TEL	78.0
ASTM Distillation 0	138
10	158
30	168
50	182
70	206
90	280
End Point	400
Recovery	98.0
Residue	1.5
Composition, Volume Percent:	
Normal Butane	0.3
Isopentane	0.9
Normal Pentane	5.5
C_6 and Heavier: Paraffins	56.1
C_6 and Heavier: Naphthenes	33.8
C_6 and Heavier: Aromatics	3.4

TABLE 2
Catforming Yield-Octane Summary

Debutanized Gasoline:			
Yield, Vol Percent of Catformer Feed	82.0	87.0	92.0
Research Octane, clear	83.5	78.6	71.5
Research Octane, 3cc TEL	97.2	94.8	90.5
Gravity, °API	62.5	63.2	64.2
Reid Vapor Pressure	7.3	6.4	5.4
ASTM Distillation Over	124	126	130
10 percent	148	152	157
50 percent	179	180	180
90 percent	276	270	268
End Point	374	385	385
Yield Structure:			
Weight Percent of Catformer Feed:			
Hydrogen	1.5	1.2	0.9
Methane	0.33	0.29	0.25
Ethane	0.67	0.51	0.36
Propane	5.4	3.6	2.0
Volume Percent of Catformer Feed			
Isobutane	5.0	3.4	1.7
Normal Butane	4.6	3.1	1.6
Isopentane	5.1	3.7	2.2
Normal Pentane	7.3	5.8	4.0

Catalytic Reforming

where gasoline plants are isolated from low-cost transportation to large refineries.

Table 1 shows the properties of the essentially depentanized natural gasoline which will be charged to the Catformer. The research octane of 78.0 at 3cc TEL is no longer high enough to permit blending of large volumes in motor gasoline. The yields and octanes from Catforming at three severity levels are shown in Table 2. These are based on actual pilot plant runs, which are in agreement with an extensive history of plant performance on a variety of charge stocks.

Although the sulfur content of the charge stock is low, hydrogenation pretreatment (Unifining) is economically justified at the higher severity levels. Unifining removes or converts coke-forming components and extends the life of the reforming catalyst. In addition, it protects the reformer from TEL contamination of the charge stock, which may occur in tank trucks used to transport both natural gasoline and leaded motor gasoline.

Makes 96 Premium. Dorchester Corporation anticipates that when the Catformer goes on stream in June, send-out octanes of 96 for premium and 90 for regular will be required to meet competition in the Texas-Oklahoma Panhandle. These octanes are somewhat lower than Gulf Coast requirements, but the altitude of approximately 4000 feet in Dorchester's marketing area gives satisfactory antiknock performance.

The composition and quality of the gasoline pools before and after Catforming are shown in Table 3. In each case the octane levels are 96 and 90, the RVP is 8.0, and the flows are 480 and 720 barrels per day, respectively, for premium and regular. The blending octane of the cat cracked naphtha was established at 95.2 at 3cc TEL by actual blends with isopentane. The blending value of 103.0 for 95 percent isopentane is lower than usually reported in the literature, but has been established by actual blends in pools ranging from 90-100 octane at 3cc TEL.

The Catformer is operated at two levels of severity to produce the optimum blends for premium and regular. This is easily accomplished in practice by changing the operating temperature while maintaining throughput constant at 1000 bpd.

About the Authors

Eckel

Worrell

J. G. ECKEL has been with Panoma Corp. (now known as Dorchester Corp.) since 1939. In Panoma he held the position of superintendent of manufacturing and marketing. In October, 1954, shortly after Panoma was sold and the name changed to Dorchester, he was made vice president and general manager, the position he now holds.

G. RICHARD WORRELL is a supervising chemical engineer in the development division of Atlantic Refining Co.'s research and development department. He joined Atlantic in 1949 after receiving his M.S. degree in chemical engineering from The Massachusetts Institute of Technology. During his first five years with the company he devoted his attention to process development of catalytic cracking and light oils. For the past three years he has been in the licensing section of the development division. He is a member of The American Institute of Chemical Engineers.

How This $550,000 Investment Will Pay Off . . .

CREDITS:	
Gasoline net	**$1344/day***
Propane and butane production	**134**
DEBITS:	
Operating costs	**316**
5-Year investment write-off	**300**
NET PROFIT:	**$ 860/day**

*** Calander day**

TABLE 3

Composition and Quality of Gasoline Pools

	Barrels Per Day	Volume Percent	Research Octane with 3cc TEL	R.V.P.
Before Catforming:				
Cat Cracked Naphtha	427	89.0	95.2	6.5
Isopentane (95%)	53	11.0	103.0	20.1
Total Premium	480	100.0	96.0	8.0
Cat Cracked Naphtha	331	46.0	95.2	6.5
Isopentane (95%)	119	16.5	103.0	20.1
Depentanized Natural	270	37.5	78.0	4.5
Total Regular	720	100.0	90.0	8.0
After Catforming:				
Debutanized Catformate (86.3% Yield)	427	89.0	95.2	6.5
Isopentane (95%)	53	11.0	103.0	20.1
Total Premium	480	100.0	96.0	8.0
Debutanized Catformate (93.4% Yield)	471	65.4	88.8	5.1
Isopentane (95%)	144	20.0	103.0	20.1
Depentanized Natural	105	14.6	78.0	4.5
Total Regular	720	100.0	90.0	8.0

TABLE 4

Economics Before and After Catforming

	Material Cost Cents/ Gal.	Before Catforming		After Catforming	
		Bbl./Day	$/Day	Bbl./Day	$/Day
Cat Cracked Naphtha	13.0	758	4140	0	0
Isopentane (95%)	11.0	172	800	197	910
Debutanized Natural	7.5	270	850	1105	3480
	....	1200	5790	1302	4390

Differential material credit	1400
Credit for propane and butane production at 4.25 cents/gal	140
Debit for Unifiner-Catformer operating costs	—330
Advantage for Catforming, not including write-off on Investment	1210/SD
Advantage for Catforming at 96% time efficiency	1160/CD
Cost of 5-year write-off on total investment of $550,000	300/CD
Net Profit	860/CD

INVESTMENT ESTIMATES

Inside Battery Unifiner-Catformer	$350,000
Tankage, Outside Battery, Two Batches Platinum	200,000
Total Investment	$550,000

Isopentane was used exclusively in the blends because Dorchester Corporation has a ready source of supply. If desired, however, normal butane can be used in regular and the Catforming severity increased with essentially no change in the economics. Dorchester thus has the flexibility to vary the sales of isopentane and butanes to take advantage of changing market differentials.

The gasoline to be marketed is relatively low-boiling, but is a completely satisfactory motor fuel in the area served by Dorchester Corporation. Vapor lock is avoided by low vapor pressure, and carburetor icing is prevented through the use of additives. Also, the Catformer incorporates several unique design features which help prevent increased volatility. It may be seen in Table 2 that the properties of the debutanized product are little different from those of the feed.

Payout in 1.3 Years. The economics of the operations with and without Catforming are shown in Table 4. The prices reflect Dorchester's current purchases and sales, except for the depentanized natural gasoline, which would bring 7.5 cents per gallon in jet fuel if sold for that end usage. After allowance for excess LPG production and for operating costs, the advantages shown is $1160 per calendar day. The total investment of $550,000 will be paid for in 1.3 years. If the investment is amortized over a five-year period, the average profit is $860 per calendar day. As octane levels increase, the profit is greater.

The road octane of the new gasoline should be substantially better than blends with cat cracked naphtha at the same research octane. Also, Dorchester uses an ignition control additive to further improve the quality.

TABLE 5

Properties of Heavy Ends in Dorchester Natural Gasoline

	Total Material	Light Fraction	Heavy Fraction
°API	38.8	43.9	28.2
Aniline Point, F.	182	167	238
Weight Percent Sulfur	0.017	0.050	0.13
Flash Point, F.	235	.....	390
Fire Point, F.	235	.....	455
Pour Pint, F.	15	.....	75
Viscosity, SSU at 100°	38.9	.....	.....
180°	.....	.....	102
210°	.....	.....	71.6
ASTM Distillation:			
Over	392	406	.....
10	432	432	.....
30	454	444	.....
50	480	464	.....
90	854	490	.....
End Point	952	596	.....
Recovery	93	95	.....
Residue	7	2.5	.....

Tail-End Bonus. An interesting sidelight is created by the long "tail end" of the charge stock. The condensate brought into the plant has an ASTM end point of about 430 F. Fractionation to a 400 F. end point produces a 3 percent bottoms cut boiling from 400 degrees to greater than 900 degrees. This material is a satisfactory railroad diesel fuel. Further fractionation of the bottoms give a good quality 180 molecular weight absorber oil, which Dorchester can use in its own plants, and a 600-degree and heavier cut which is an ideal catalytic cracking charge stock after Unifining. Properties of these materials before Unifining are shown in Table 5. Although the volumes are small, premium prices of more than 9 cents per gallon are anticipated.

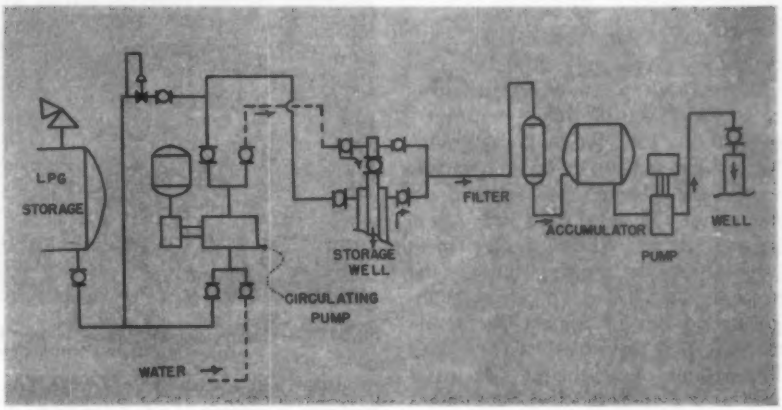
Another interesting sidelight is the availability of a concentrated normal pentane stream. Currently this has an attractive market as a chemical raw material; but, if this fails, an isomerization process is available to convert the normal pentane to isopentane. Since Dorchester already has a pentane splitter, isomerization could be installed at very moderate investment. Dorchester feels this is good protection in case of loss of the chemical market. ##

Underground Storage Cuts Cost 90%

Jack O. Anderson
The Atlantic Refining Company
Crane, Texas

UNDERGROUND STORAGE project at the Denton gasoline plant (Lea County, New Mexico) has cut LPG storage costs 90 percent. Deposition of anhydrite crystals on 3½-inch tubing was the only major difficulty encountered. The estimated cost of the project was approximately $2.15 per barrel of storage based on present well capacities. This cost compares very favorably with $20 per barrel for above-ground propane steel storage. Additional enlargement of the cavities could easily reduce the cost to $1 per barrel.

The gasoline plant is operated by The Atlantic Refining Company and is jointly owned by 28 others. Here's how the cavity was developed, drilled and washed.



FIGURE—Flow scheme for storage system shows circulation of fresh water into the storage well and the injection of brine effluent.

At Denton gasoline plant, salt cavities for LPG storage were developed at a cost of $2.15 per barrel; enlargement would reduce cost further.

EARLY DEVELOPMENT

Immediately after the completion of the Denton gasoline plant in the early part of 1954, the seasonal demand for the plant's liquefied petroleum products was recognized. The surrounding agricultural area consumed far more products during specific irrigation periods than during the remainder of the year. The industry had found that underground LPG storage proved an effective hedge against seasonal fluctuations in supply and demand. Therefore, a study was commenced in May, 1954, of the possibility of utilizing two 50,000-barrel underground cavities for the storage of propane and butane.

September, 1954. An underground storage project proposal was submitted to the co-owners of the Denton gasoline plant for their approval. A simplified flow diagram of the project is shown in Figure 1. The project proposal included the installation of two electric motor driven horizontal duplex reciprocating pumps capable of circulating water or injecting liquefied petroleum product, two storage wells complete with wellhead equipment and four strings of pipe; and, a salt water disposal system with full flow filters, backwash tanks, two triplex vertical salt water injection pumps and a salt water disposal well. The use of a salt water disposal well was taken as precaution to prevent any possible contamination of surface water from the brine effluent.

DRILLING STARTS

March 5, 1955. The drilling program was initiated with the rigging-up of a rotary drilling rig at LPG Well 1. This well was to be the propane storage well.

As shown in Figure 2, a surface string of 13⅜-inch casing was set and cemented at 352 feet. The hole was then drilled to approximately 2200 feet where a string of 9⅝-inch casing was set and cemented at 2186 feet. The well bore was then cored and logged from a depth of 2240 to 2742 feet, which is the total depth of the well. The core samples were analyzed in an attempt to locate the shale and anhydrite stringers that were intermeshed throughout the salt strata. An intermediate string of 7-inch casing was hung open hole at 2323 feet. The

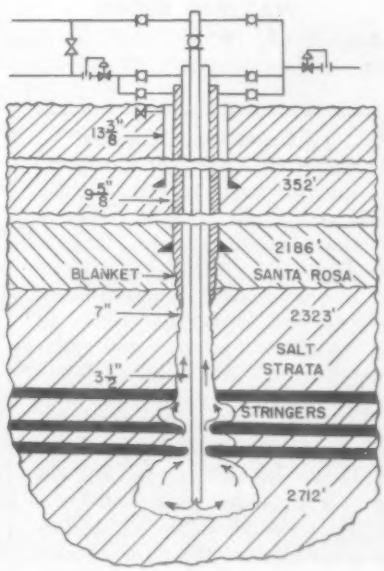


FIGURE 2—Storage well showing piping arrangement and author's conception of cavity.

3½-inch tubing string was hung open hole at 2712 feet.

LPG Well 2 (butane) was located approximately 1320 feet directly south of the propane storage well. This well was likewise installed with four strings of pipe set at approximately the same depths.

The salt water disposal well was drilled approximately 1100 feet west of the storage wells. A surface string of 8⅝-inch casing was set and cemented at 331 feet and a 6¾-inch hole was drilled to 1836 feet. A string of 4½-inch casing was set and cemented at 1796 feet. This well was to be used for the disposing of effluent brine during the washing phase of the program. To insure an adequate injection volume of brine effluent, the disposal well was sand-fraced with 500 gallons of 10-pound salt water and 5000 pounds of sand. After completion of the sand-fracturing process, it was possible to inject 200 gallons per minute at approximately 1300 pounds of pressure.

Prior to initiation of the washing phase, 2940 gallons of lean oil was injected into the annular space between the 9⅝-inch and 7-inch casing in LPG Well 1 (propane). This was to form a blanket in the upper section of the cavity and minimize the possibility of washing under the 9⅝-inch cement shoe. This is shown in the storage well diagram (Figure 2).

WASHING BEGUN

August 19, 1955. The initial wash rate was approximately 35 gallons per minute. The wash rates were increased periodically, maintaining a salt water effluent of 24° Baume.

September 15, 1955. Some 2750 gallons of lean oil was injected into LPG Well 2 (butane). Washing commenced at a very low rate to minimize plugging of the filter beds. The wash rate on Well 2 was periodically increased until, on October 24, the wash rates going to each well had been equalized at 80 gallons per minute. The salt water effluent on Well 1 was 24° Baume and on Well 2 22° Baume.

December 9, 1955. While fresh water was being bypassed to clean the salt water disposal facilities, a mud slide occurred in the lower part of Well 1. Flows were immediately reversed in an attempt to remove the plug. This operation proved unsuccessful. The mud level in the 3½-inch tubing was measured by means of a wire line and found to be at 2363 feet, approximately 342 feet above the bottom of the tubing. It was necessary to remove the 3½-inch tubing from the well bore. Inspection of this tubing showed that a layer of anhydrite crystals, varying in thickness from ⅛-inch to ⅜-inch, had deposited on the outside of the tubing. It was necessary to remove the crystals by hammering and scraping the pipe. The 3½-inch tubing string was re-run, minus one joint. It was decided at that time to defer washing Well 1 until Well 2 had been completed. The theory was that deposition of scale was partially caused by low velocity and low volume of fresh water.

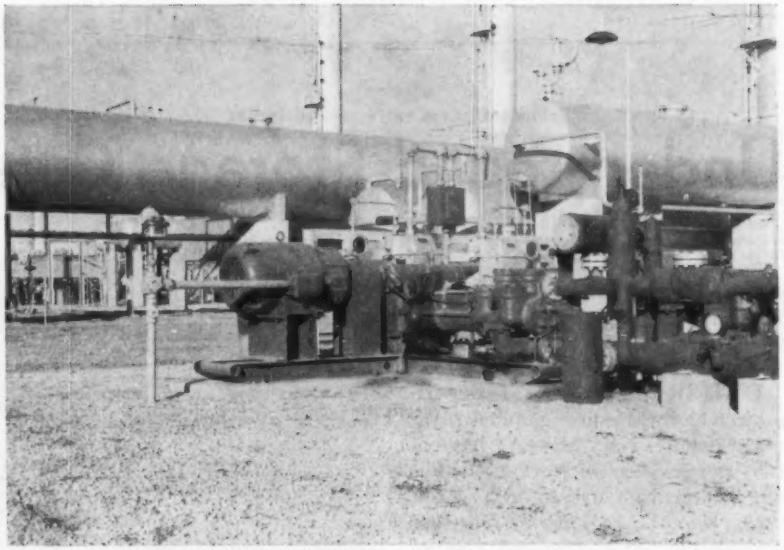


FIGURE 3—This reciprocating pump is used for product injection and fresh water circulation.

January, 1956. The washing phase of the project continued without interruption until the early part of January, 1956, at which time the high pressure differential between the 3½-inch tubing and the 7-inch casing caused a high pressure shutdown to actuate. It was necessary at this time to remove the 3½-inch tubing in Well 2 and chip off the heavy anhydrite crystals which had deposited on the tubing. Other than the problem of scale deposition on the 3½-inch tubing of each well, no unusual difficulties were experienced in this washing operation.

Upon completion of the washing phase of each well, the valves and equipment on the wellhead were removed, cleaned and pressure tested. A 24-hour high pressure test was placed on each cavity to insure that no leaks had developed. The lean oil blanket was removed from each well and the respective product blanket, propane for Well 1 and butane for Well 2, was injected into the annular space.

A total of 407,494 barrels of fresh water was circulated into the cavity of LPG Well 1, and 455,456 barrels of brine effluent were removed from this well. This effluent contained a total of 47,344,651 pounds of salt. The fresh water circulated into LPG Well 2 was 331,567 barrels. This created 370,647 barrels of brine effluent. The salt dissolved in Well 2 was 37,-

About the Author

JACK O. ANDERSON is plant superintendent of Atlantic Refining Co.'s block 31 pressure maintenance plant, Crane, Texas. Prior to joining Atlantic five years ago, Anderson spent two and one-half years in equipment operation and maintenance for Sun Oil Co.'s Jameson gasoline plant. Anderson received his B.S. degree in mechanical engineering from the University of Texas in 1949. He is a registered professional engineer in New Mexico and is a member of the New Mexico Society of Professional Engineers.

FIGURE 4—Salt water injection system includes these filters, accumulator tank, redwood backwash tanks and gas-engine driven pumps.

470,188 pounds. This concluded the initial washing phase of each of the underground storage wells.

HOW CAPACITY WAS CALCULATED

The capacity of each well was calculated by measuring the volume of fresh water circulated, averaging the salt concentration of the brine effluent by means of hydrometer and knowing the factor for barrels of void per pound of salt removed from the strata. This factor was determined by taking a sample of the core from the salt section and measuring the pounds of salt per gallon of volume it represented. By use of a graph plotted from this data and averaging the brine saturation, the cavity formed in this period could be calculated from the volume of fresh water circulated.

SPECIAL FEATURES MADE IT SAFE

Safe operating characteristics were the forethought both in design and in operation of this underground storage project. Extensive coring, analyzing and testing were required before the decision was reached to inject the salt water into the lower Santa Rosa formation. This was to prevent any possible contamination of surface water or possible future water supply sands.

A high pressure shutdown switch was provided on the discharge of the product and water injection pumps. Excess flow shutdown valves were provided on the product inlet line and the outlet salt water line of each well to protect the area in case of line break. High pressure and gravity shutdown devices were provided at the disposal unit to protect this equipment and area if product should ever pass into the brine disposal water line.

A variable speed device was utilized for controlling the speed of the gas engine driven salt water injection pumps. This device is operated from the salt water level in the accumulator tank and will position the throttle linkage on the natural gas engine driven injection pumps. ##

How Cavity Works

Use of salt strata below ground surface dates back to 1949. A salt cavity is formed by circulating a stream of fresh water down through the inside of a string of tubing. The fresh water contacts the face of the salt layer and dissolves the salt creating a void in the salt section. The brine solution is removed through the annular space of an intermediate string of pipe. The brine is then disposed of by some means on the surface.

Upon completion of the washing phase of the program, the petroleum is stored by injecting it into the top of the cavity section through the intermediate string of pipe and removing the brine from the bottom of the cavity by use of the tubing. The cavity may be filled with product until the interface level between the brine solution and the product reaches the bottom of the tubing.

The removal of product is accomplished by displacing the product with salt water, fresh water or a gas blanket. The cavity is enlarged upon displacing the storage product with fresh water; thus, dissolving more salt and creating additional void. When maximum capacity is reached, saturated salt water or a gas blanket is utilized to remove the product. Recoveries in the order of 90 to 95 percent of the volume of product stored have been experienced by some companies in previous installation, although unusual formation structures and different washing operations may cause this percentage to vary.

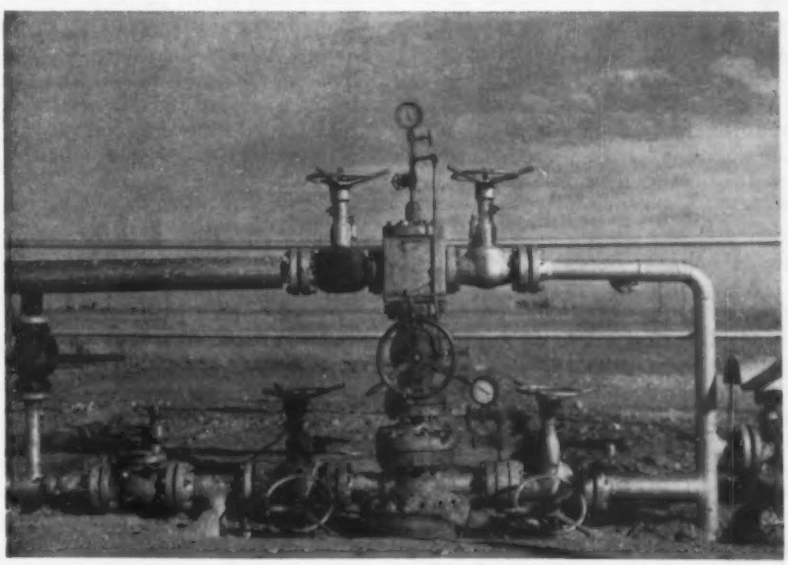


FIGURE 5—This manifolding at storage wellhead is necessary for washing, product injection or product removal.

a Special Report

NATURAL GASOLINE

How Safe Is Your Gasoline Plant?

Safety patterns—good or bad—are set by management and the technical men.

M. L. Powers Director Business and Industrial Services
University of Oklahoma, Norman, Oklahoma

DESIGN AND OPERATION of a safe natural gasoline plant depends on the way two questions are answered:

- Is management willing to pay the price for safety?
- Are technical men living up to their safety responsibilties?

A natural gasoline plant is as safe as its design and construction. If management policy over-emphasizes the "let's cut cost" factor, safety features may be reduced proportionately.

By the same token, safety in design and plant operations depends on the technical man's willingness to meet the legal, ethical and moral safety responsibilities he accepted when he entered the engineering profession. How can these responsibilities be met?

Design for Safety. The first responsibility of the technical man is the same now as it has been in the past—*to design plans for safety.* Continued attention must be given to the relations and locations of processes and operations. When precautions aren't taken in these areas an accident in one spot can set off a chain reaction —with disaster as the result.

For a unit to be safe, each piece must be safe. Connecting pieces, such as walkways, access areas, stairways and structures must likewise be safe. Safe equipment originates in safe design and safe design starts with the design engineer.

While inclusion of safety features for future operation and maintenance in the design of a unit is largely dependent upon the capabilities of the design engineer, it is still the responsibility and to the best interest of management to see that policy is set up to make such features possible.

More attention should be given to "built-in" safety and fire control systems when constructing natural gasoline plants. It may not be possible for men to go near a major fire. However, with the "built-in" systems fire may be localized, thus protecting lives and property.

Safety in Operations. The technical man should know more about what the consequences of an accident may be. He should know more about the nature of chemicals and chemical reactions in processes, and the result of a change in conditions.

Recently a plant superintendent had an accident in handling ammonia. His eyes received severe damage and it is just short of a miracle that he has his eyesight today. He said the men working at the plant did not know ammonia was dangerous. The technical man *should* know—and he is in the best position to tell plant personnel of the dangers involved.

Supervisory and technical personnel should keep plant employes informed and alert to every safety factor, no matter how elemental it may seem. Some of those basic safety precautions include:

- Knowledge of the practical aspects of hydrocarbon behavior as it affects safety, i.e., the explosive range of propane-butane air mixtures are much broader than gas-air mixtures. Should a leak occur, personnel should know the precautions to take.
- Knowledge that hydrogen sulfide is lethal. If a plant is handling sour gas, personnel must be trained to detect its taste-smell sensation so that action can be taken. Rescue breathing apparatus should be provided for such situations, and personnel should know how to use it.
- Don't break hoses under pressure. This may sound too simple, but serious accidents have resulted because a plant employe didn't know what the consequences would be.
- The same is true of another elemental safety rule—never break a flange without first having positive knowledge that the line is not under pressure. Here again, accidents have resulted because employes were not informed.

And these are just a few examples. To sum it up in one sentence, supervisory and technical personnel should take a more active interest in accident prevention and in training personnel for the safe handling of their jobs.

Line Management is Responsible. The statement was made recently that engineers are the worst safety offenders. If this is true, it is not entirely the engineers' fault.

The responsibility for safety, as with all other problems of operation, rests with line management. In recent interviews, several line managers expressed the opinion that most engineers would react favorably and actively to safety and accident prevention if line management was actively interested itself in teaching safety to operating personnel.

One of the managers said it was his experience that when the responsible superintendent or manager promoted and encouraged safety, engineers in the organization would take an active part in putting on demonstrations, giving talks at safety meetings and other activities, passing on a part of their knowledge for the benefit of the operating personnel.

Most companies today have training programs for young engineers entering the industry. If line management recognizes safety as being important, safety will be included as an important part of the engineer's training.

It must be remembered that safety is included in the engineer's formal education so far as design is concerned. However, not much attention is paid to safety in operations. Operations safety is the responsibility of the company that hires a man.

Management must be the ultimate control. The attitude of management toward safety and training is directly reflected in the attitude of the technical men in the organization. Safety progress can succeed or fail because of this one factor. ##

Better Stripping & Absorption Factors

These charts can save time and increase accuracy in tower evaluation. The average stripping and absorption factors are based on a different approach. Assumption is that factors on successive stages differ by a constant multiplying factor or geometric gradient.

R. O. Shelton
Phillips Petroleum Company, Bartlesville

THIS SERIES of charts permits rapid evaluation of average absorption or stripping factors in a separation tower. The averages obtained can be used in conventional calculation methods to compute the separation which can be achieved in a tower. The average stripping and absorption factors are based upon the assumption that the factors on successive stages differ by a constant multiplying factor (geometric gradient). The parameters involved in the determination of average factors are the terminal conditions of a given tower. Eleven charts extend considerably previous work along the same lines.

Extends Previous Work. The concept of absorption and stripping factors for use in separation calculations has been a useful one. The general technique of stripping and absorption factors has been developed over the last several years in a series of papers by Kremser[3] Souders and Brown[4] Horton and Franklin[5] Edmister[6] and McIntire, Shelton and Hachmuth[1,2].

While the basic absorption-stripping factor equations are theoretically rigorous the calculations involved are too lengthy and require too much knowledge about liquid and vapor gradients to make their use practical. Consequently most absorption-stripping factor calculation procedures involve the assumption of an average factor to simplify calculations. Reference (1) presents the derivation of an average factor based on the assumption that the stripping-absorption factors have the relation of a geometric gradient. The various advantages of this assumption were discussed in the previous paper but may be summarized as follows:

- Average absorption and stripping factors can be read off the same charts.
- Average factors are a function of terminal tower conditions.
- Answers obtained through the use of these factors are generally conservative.

The purpose here is to present a series of charts designed to permit easy evaluation of average factors from terminal tower conditions. Eleven charts are given representing a different approach and a considerable extension over those contained in Reference (1).

Theory and Equations. The degree of separation for one component achieved in a tower section as the result of a stripping action can be written in terms of stripping factors as follows:

$$\frac{1}{1-f_s} = 1 + S_n + S_n S_{n-1} + \ldots + S_n S_{n-1} \ldots S_2 S_1 \qquad (1)$$

The nomenclature is given in the Nomenclature. The analogous equation in terms of absorption factors is:

$$\frac{1}{1-f_a} = 1 + A_1 + A_1A_2 + \ldots + A_1A_2 \ldots A_{n-1} A_n \qquad (2)$$

Equations 1 and 2 are theoretically rigorous but are difficult to use because the stripping or absorption factors on each stage are unknown. This lack of knowledge is usually bypassed by the assumption of an average separation factor. This average is generally estimated from the terminal separation factors.

One method for the determination of an average separation factor from the terminal conditions was presented in Reference (1). By this method, a geometric

gradient is assumed for the separation factors. The assumption resolves to the following equations.

$$\begin{aligned} S_{n-1} &= kS_n \\ S_{n-2} &= k^2S_n \\ \text{or } k &= (S_1/S_n)^{1/n-1} \end{aligned} \qquad (3)$$

Equation 1 then becomes

$$\frac{1}{1-f_s} = 1 + S_n + S_n^2k + S_n^3k^3 + S_n^4k^6 + \ldots$$

$$S_n^n k^{1+2+3+\ldots+(n-1)} = \frac{S_*^{N+1} - 1}{S_* - 1} \qquad (4)$$

Equation (2) can be modified in an analogous manner. Equation (4) permits the evaluation of the fraction of a component stripped or, if desired, S_* but such calculations are lengthy. Charts were computed to facilitate this work. The reader is referred to (1) and (2) for details of derivation and justification of this method over other methods of obtaining averages but, in general, the geometric averages have been shown to give more reliable results than the usual assumption of a straight line average.

How to Use Charts. Figures 1 through 9 are plots based on the assumption of a geometric separation factor gradient. Plots are given for nine different values of A_n/A_1 or S_1/S_n ranging from 0.6 to 5.0. This range is greater than that of previous charts and should cover most of the usual conditions. The plots are used as follows:

1. Evaluate stripping or absorption factors at terminal conditions of the separation section to be evaluated.
2. Select the chart for the proper ratio of S_1/S_n or A_n/A_1.
3. Read horizontally across the chart at the proper theoretical stage level until the line for the appropriate S_n or A_1 value is reached.
4. Read the top scale to obtain the fraction of a component which is stripped or absorbed. Read the bottom scale to find the fraction not stripped or fraction not absorbed.
5. Interpolate linearly between charts if necessary.

As an example, in a ten tray tower where S_n or $A_1 = 1.0$ and S_1 or $A_n = 1.5$ then from Figure 5, $1 - f_s$ or $1 - f_a = 0.0358$ and f_s or $f_a = 0.9642$.

Figure 3 is a plot with the parameter S_1/S_n or $A_n/A_1 = 1.0$. This plot is the same as the usual separation factor chart. That is, the separation factors are the same on each stage and the series was evaluated at a constant (or average) value. The chart has been presented in the literature in various forms and is presented here as an aid in interpolation and to complete the set. Figure 3 can also be used in conjunction with the other charts to evaluate the average stripping factor, S_*, or the average absorption factor, A_*. These averages are based on the assumption of a geometric stripping factor gradient, of course. To determine S_* or A_*, first determine from the charts the appropriate value of fraction not stripped or fraction not absorbed. Using this value, refer to Figure 3 and locate the intersection with the number of theoretical stages. The value of S_n or S_1 at this point is equal to S_* or A_*, respectively. In the example of the previous paragraph, S_* or A_* is equal to about 1.17.

Figure 10 shows a plot of one theoretical stage. This chart serves to complete the other charts since the one-stage values are common to all. Figure 10 can be used for flash calculations.

Figure 11 is an example of a cross plot made for a value of ten theoretical stages. This type of plot is very useful for problems where the number of theoretical stages is fixed.

It is interesting to note that Figures 1 through 9 each show a critical value of S_n or A_1. Below this critical value the degree of separation which can be obtained is limited and at infinite stages f_s or f_a becomes equal to S_n or A_1, respectively. When S_n or A_1 is greater than the critical value, the separation which can be obtained by increasing stages is unlimited. Knowledge of the critical value of S_n or A_1 at a given ratio of terminal conditions is therefore quite useful. Figure 12 is a plot of these critical values as a function of the ratio of terminal conditions. At ratios less than 1, the critical value of S_n or A_1 is 1.

Figures Continued on Next Page

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[1] McIntire, R. L., Shelton, R. O., and Hachmuth, K. H., "Development of Theory and Charts for Absorption and Stripping Factor Methods," Proceedings, thirty-first annual convention Natural Gasoline Association of America, April 30, May 1 and 2, 1952, pages 24-37.

[2] Shelton, R. O., McIntire, R. L., and Hachmuth, K. H., "Fractionator Calculations by the Absorption and Stripping Factor Method," Proceedings, thirty-first annual convention Natural Gasoline Association of America, April 30, May 1 and 2, 1952, pages 38-47.

[3] Kremser, A., National Petroleum News, 22, No. 21, page 48 (May 21, 1930).

[4] Souders, Matt, Jr., and Brown, G. G., Industrial Engineering Chemistry, 24, 519 (1932).

[5] Horton, G., and Franklin, W. B., Industrial Engineering Chemistry, 32, 1384 (1940).

[6] Edmister, W. C., Industrial Engineering Chemistry, 35, 837 (1943).

NOMENCLATURE

A	Absorption factor = L/KV
S	Stripping factor = KV/L
k	Constant relating separation factors on consecutive steps
f_a	Fraction of component absorbed
f_s	Fraction of component stripped
$1 - f_a$	Fraction of component not absorbed
$1 - f_s$	Fraction of component not stripped
L	Equilibrium liquid falling from separation stage, moles/unit time
N	Number of theoretical separation stages
V	Equilibrium vapor rising from separation stage, moles/unit time
K	Equilibrium ratio = y/x
y	Mol fraction of a component in the vapor phase
x	Mol fraction of a component in the liquid phase

Subscripts

1	First or bottom stage in a separation unit
n	Last or top stage in a separation unit
*	Denotes average factor

About the Author

RUSSELL O. SHELTON is a group leader in the machines computations group of Phillips Petroleum Co., Bartlesville, Okla. In this position he supervises engineering computations on an electronic computer. He has had three years pilot plant experience on separation processes, and six years experience in adapting chemical engineering processes analysis and other problems to electromechanical and electronic computers. Shelton received a B.S. degree in chemical engineering in 1948 from Northwestern University, and an M.S. degree in chemical engineering in 1952 from Oklahoma A&M.

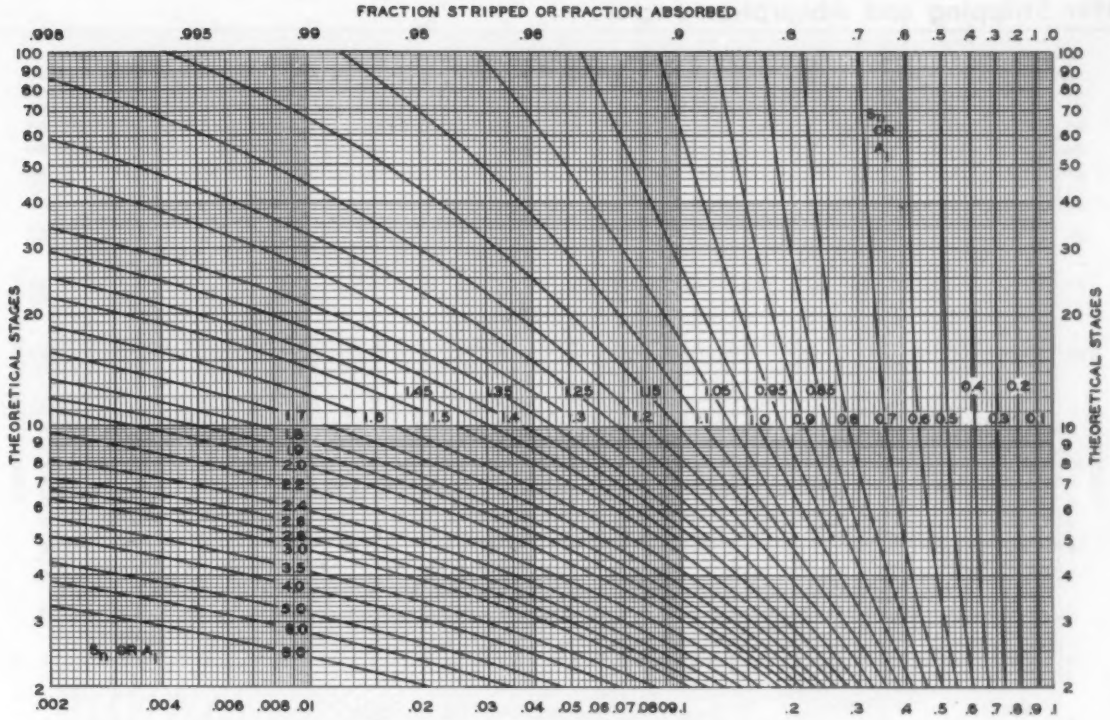

FIGURE 1—Geometric-gradient separation chart.

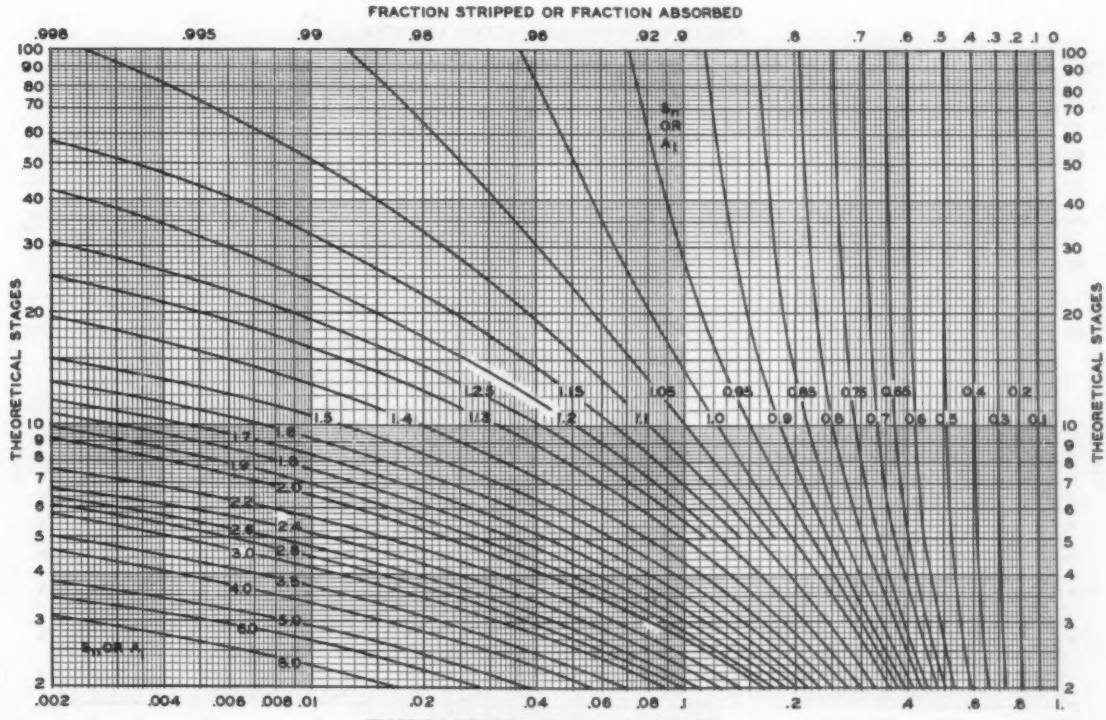

FIGURE 2—Geometric-gradient separation chart.

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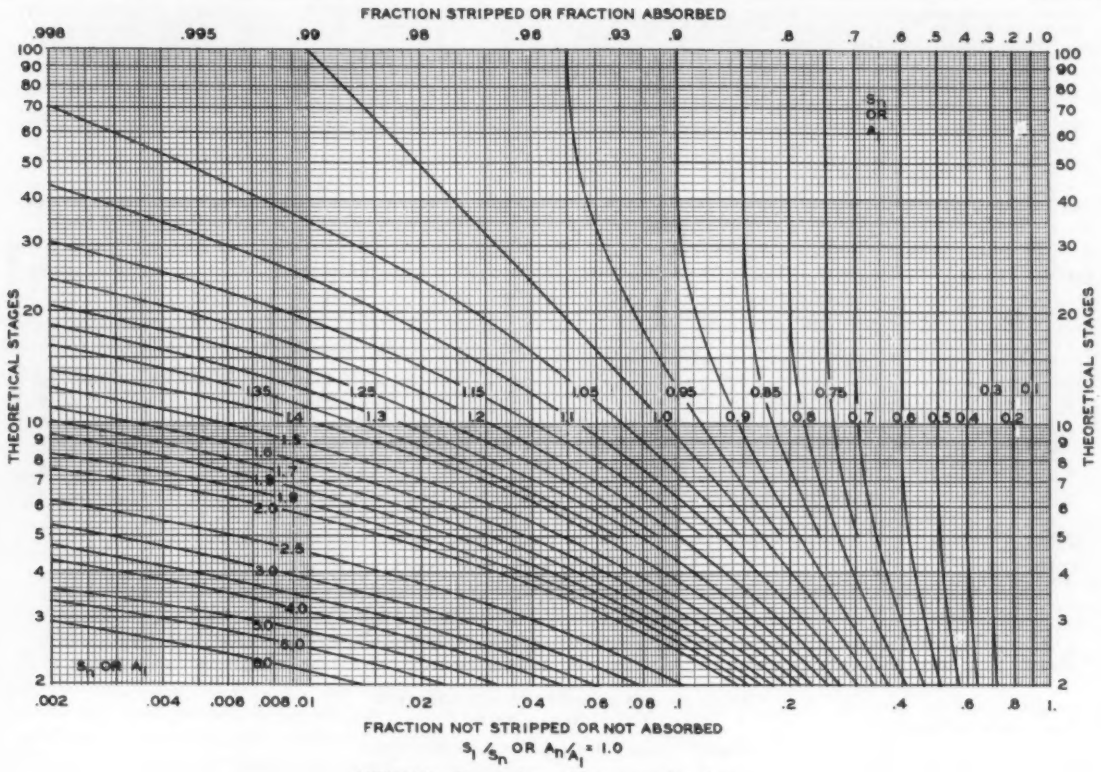
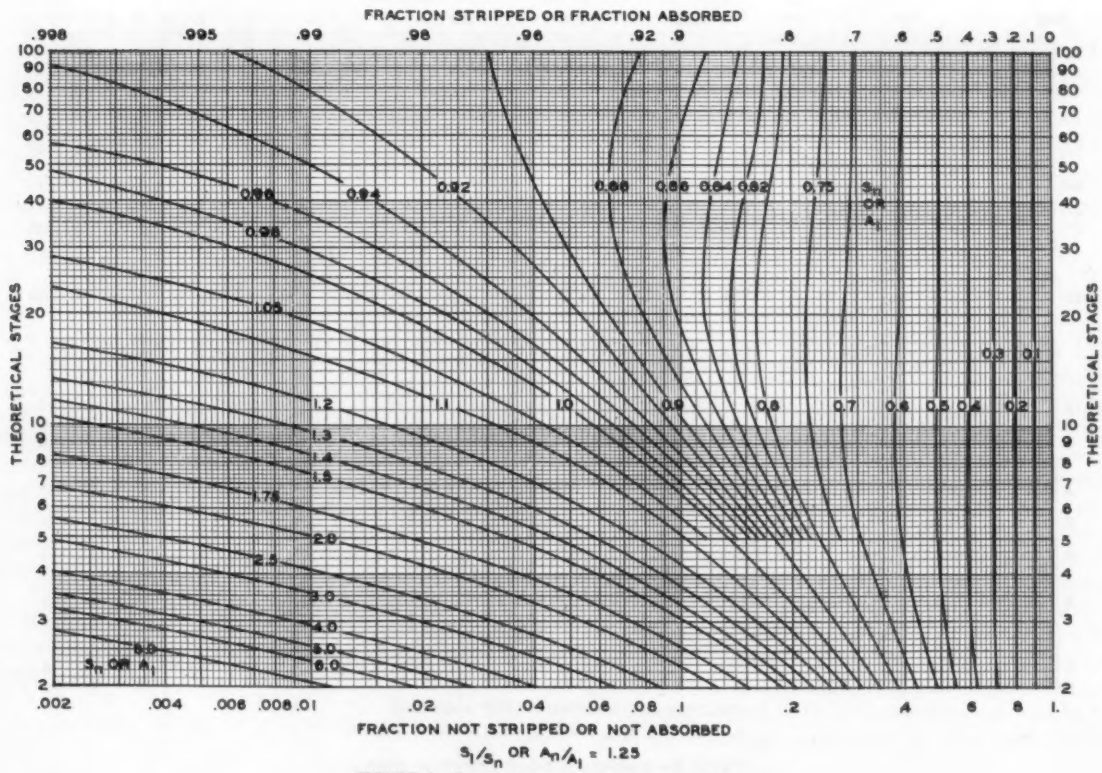

FRACTION STRIPPED OR FRACTION ABSORBED
.998 .995 .99 .98 .96 .93 .9 .8 .7 .6 .5 .4 .3 .2 .1 0
THEORETICAL STAGES
S_n OR A_1
FRACTION NOT STRIPPED OR NOT ABSORBED
S_1/S_n OR A_n/A_1 = 1.0

FIGURE 3—Geometric-gradient separation chart.


FRACTION STRIPPED OR FRACTION ABSORBED
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THEORETICAL STAGES
S_n OR A_1
FRACTION NOT STRIPPED OR NOT ABSORBED
S_1/S_n OR A_n/A_1 = 1.25

FIGURE 4—Geometric-gradient separation chart.

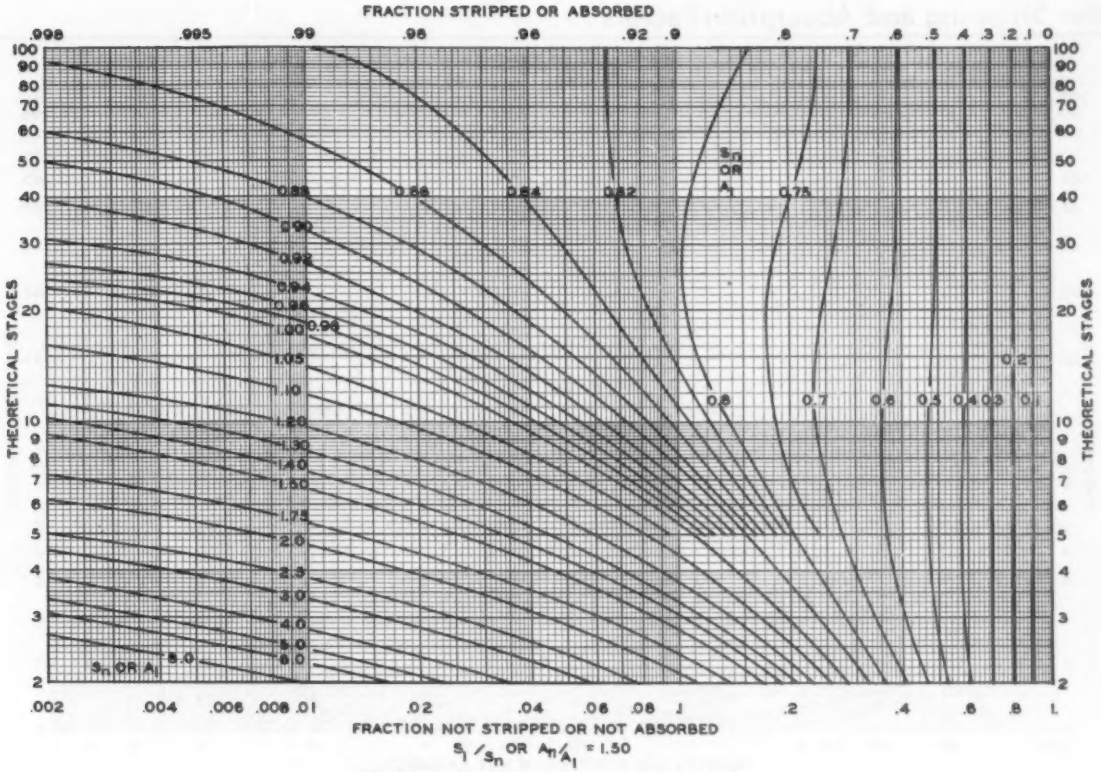

FIGURE 5—Geometric-gradient separation chart.

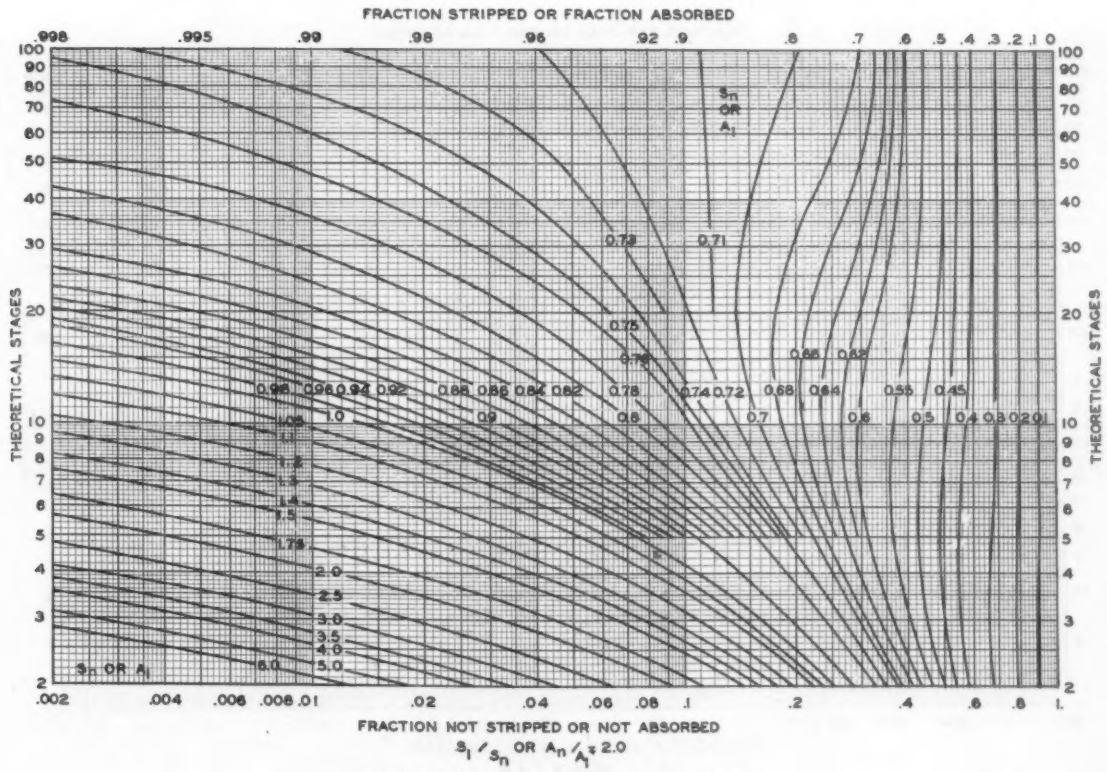

FIGURE 6—Geometric-gradient separation chart.

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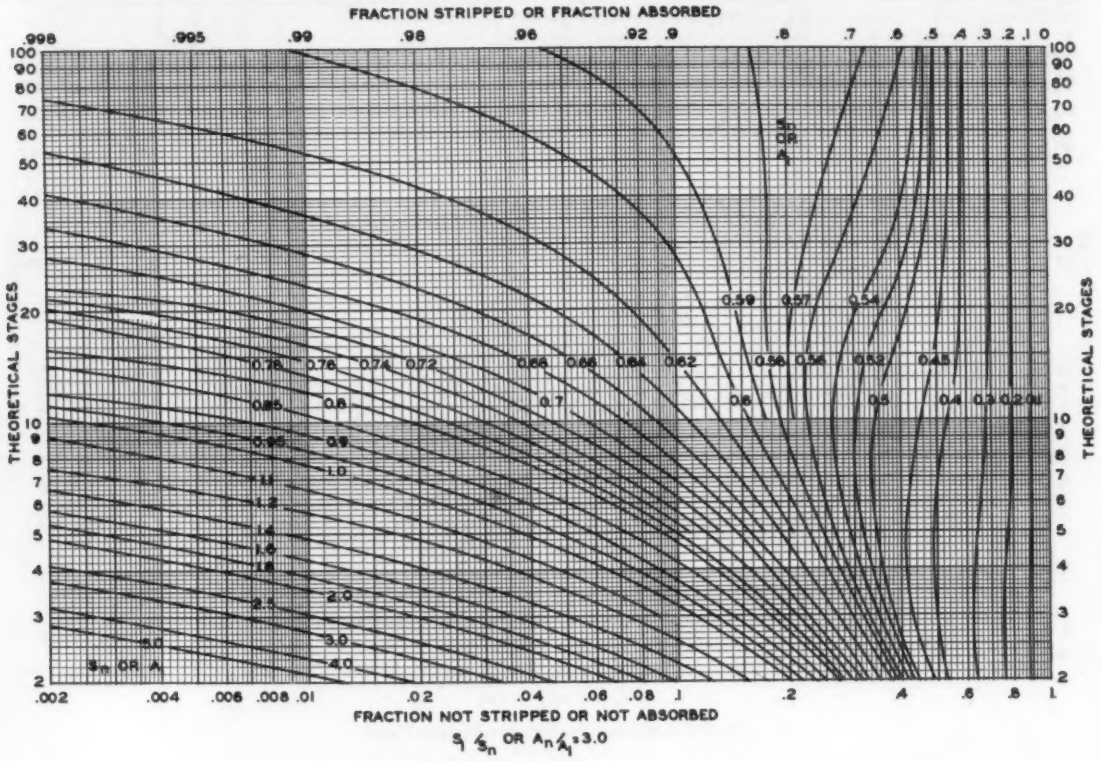

FIGURE 7—Geometric-gradient separation chart.

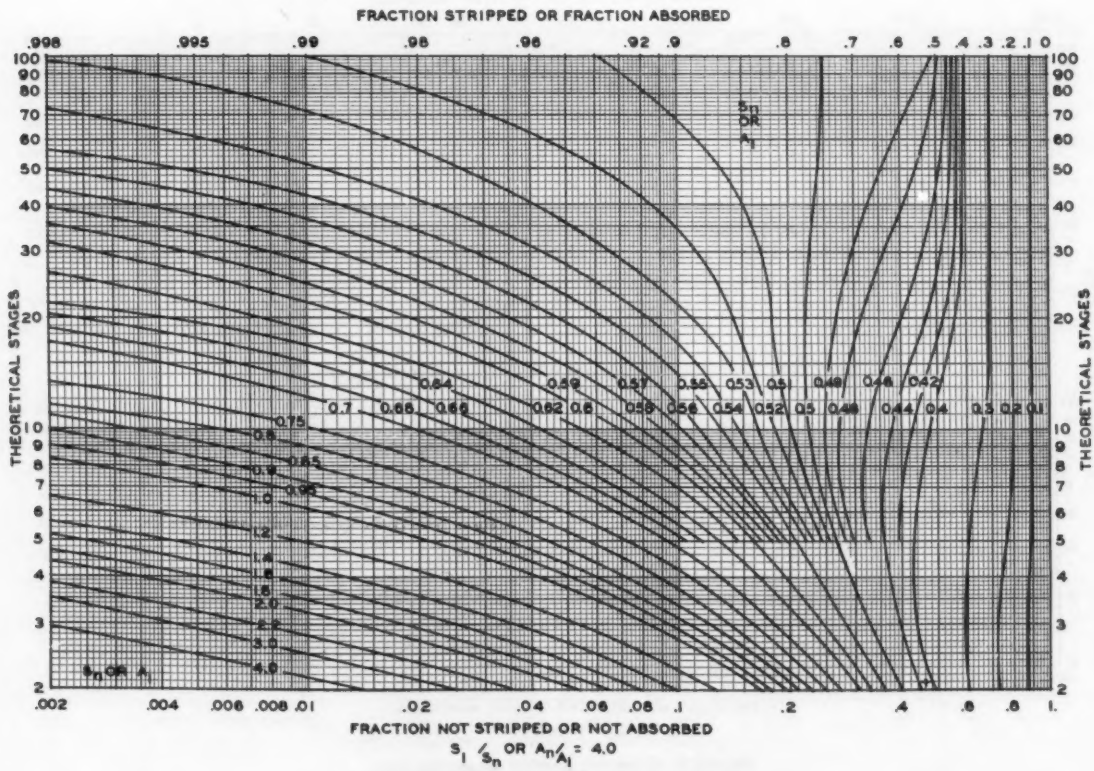

FIGURE 8—Geometric-gradient separation chart.

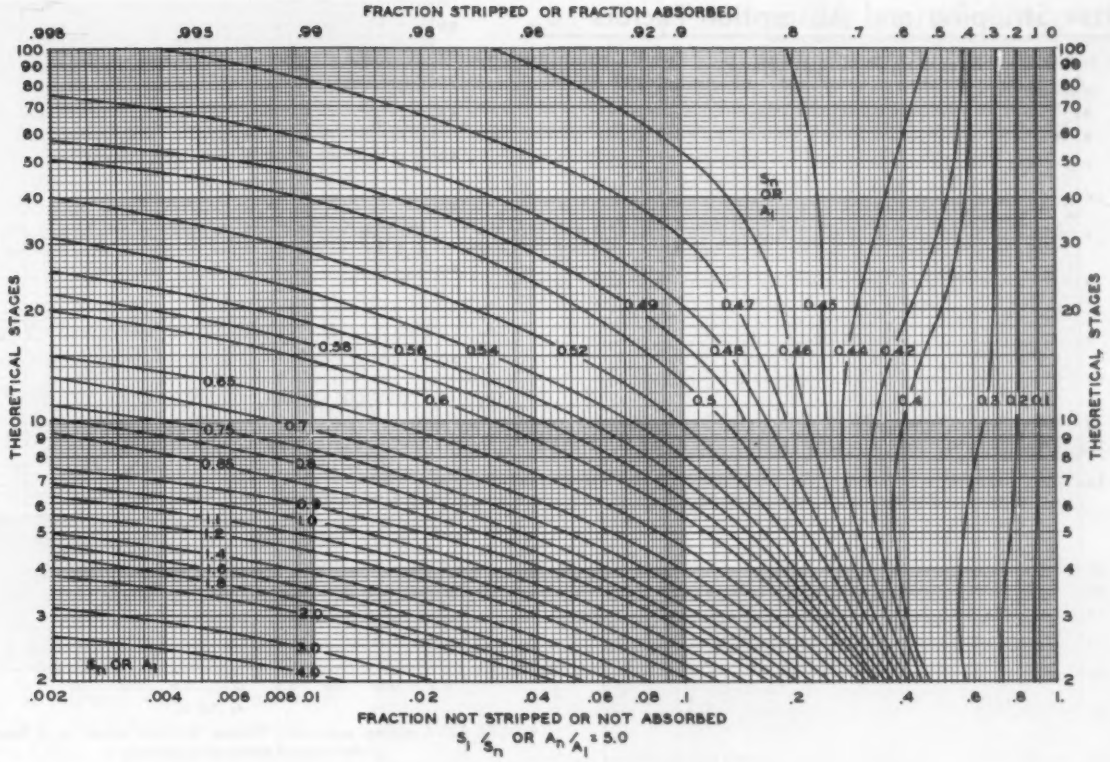
FRACTION STRIPPED OR FRACTION ABSORBED
THEORETICAL STAGES
FRACTION NOT STRIPPED OR NOT ABSORBED
$S_1 \leq S_n$ OR $A_n \leq A_1 = 5.0$

FIGURE 9—Geometric-gradient separation chart.

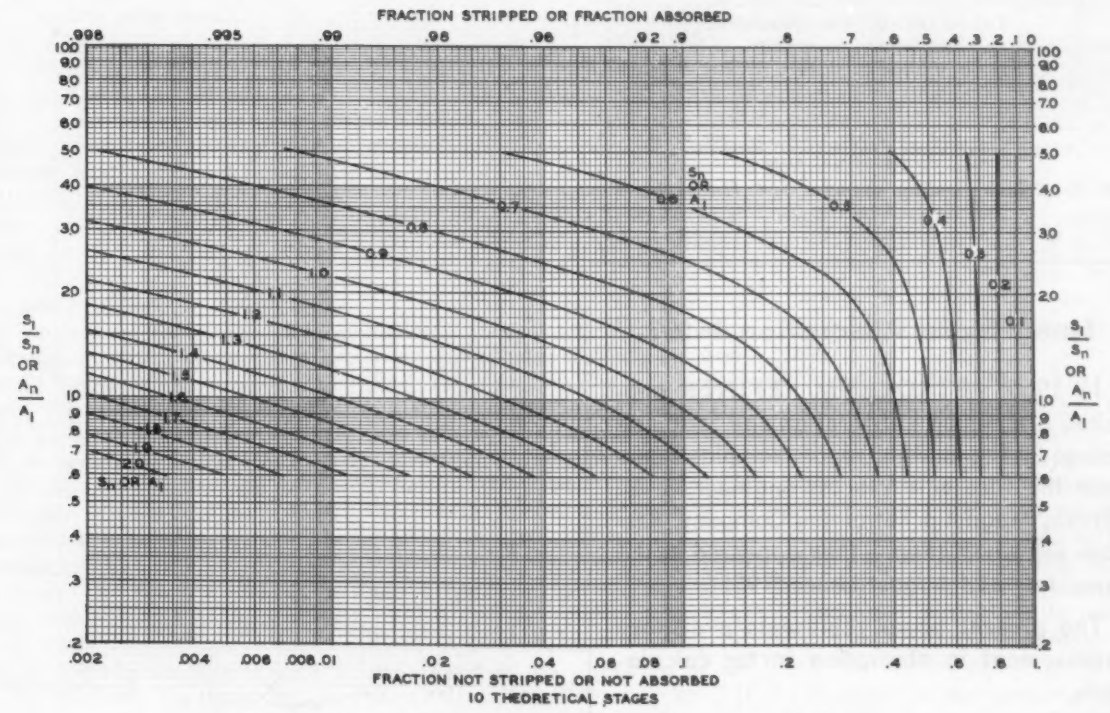

FIGURE 11—Geometric-gradient separation chart: For 10 theoretical stages.

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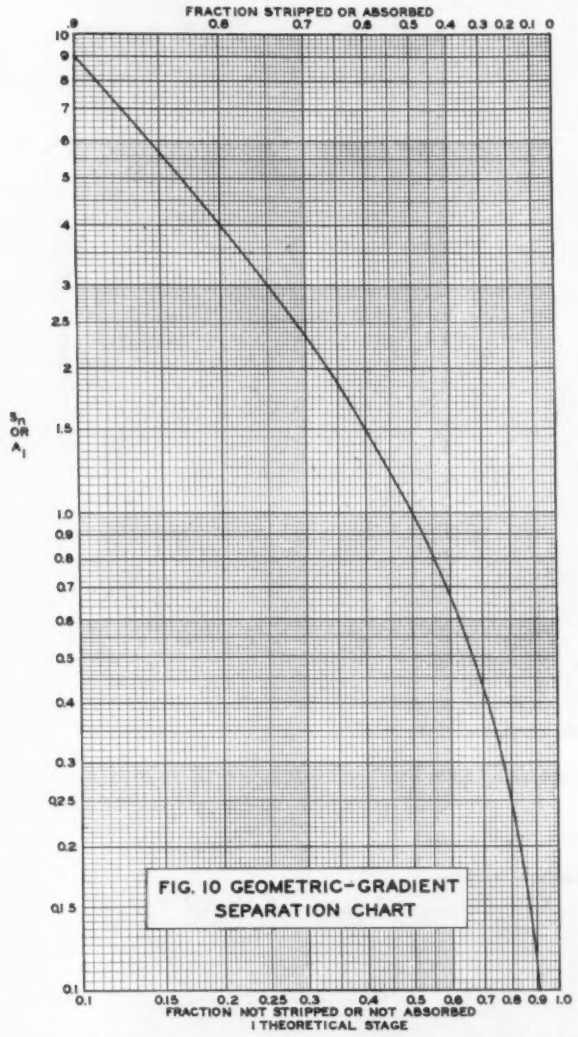

FRACTION STRIPPED OR ABSORBED
FRACTION NOT STRIPPED OR NOT ABSORBED
1 THEORETICAL STAGE
FIG. 10 GEOMETRIC-GRADIENT SEPARATION CHART

FIGURE 10—Geometric-gradient separation chart: For one theoretical stage.

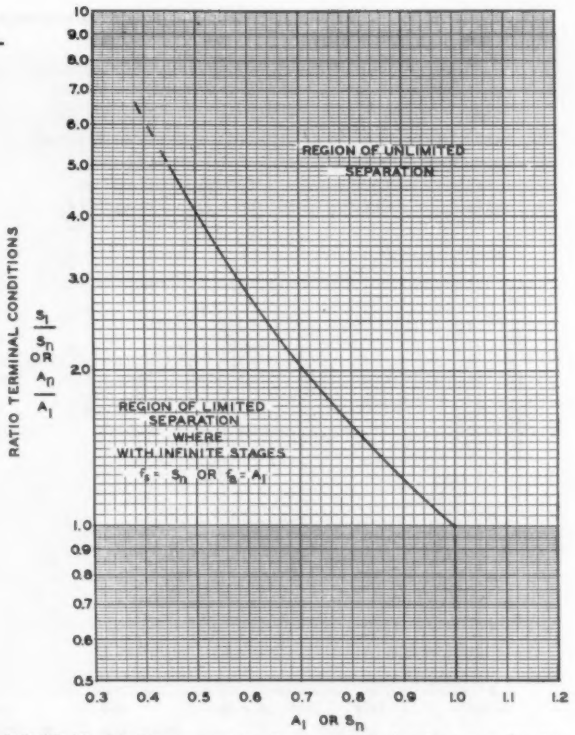

REGION OF UNLIMITED SEPARATION
REGION OF LIMITED SEPARATION WHERE WITH INFINITE STAGES
RATIO TERMINAL CONDITIONS
A_1 OR S_n

FIGURE 12—Limiting separation factors: Critical values as a function of the ratio of terminal conditions.

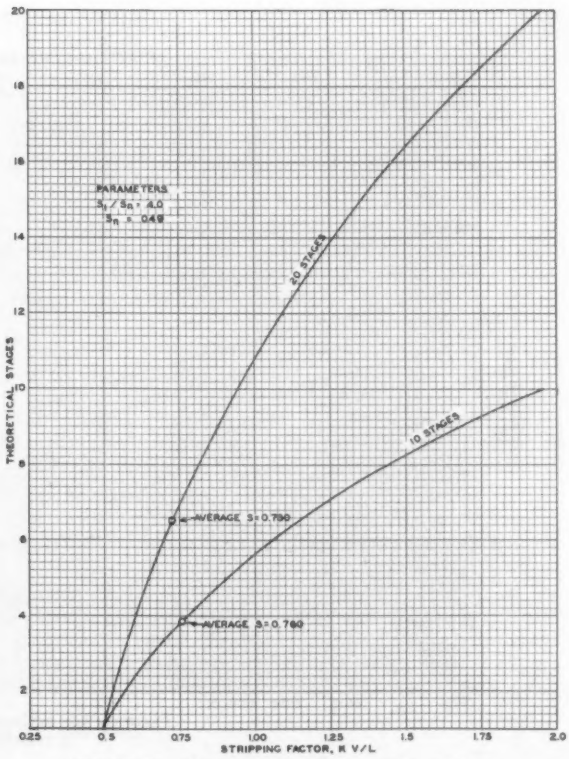


FIGURE 13—How stages affect geometric gradient.

Need More Absorption Info?

In 1955, PETROLEUM REFINER published a series on "Absorption and Stripping Design." The method and examples came from the files of a process engineer, R. H. Parekh, Magnolia Petroleum Company. Perhaps you saved them—they appeared in the June, July and August issues (1955).

The present paper represents a distinct improvement in absorption factor calculations.

##

South Hampton Steps Up Platformer

John C. Breaker
South Hampton Company
Houston

To its existing catalytic reformer installation, this natural gasoline processor is adding prefractionation facilities to increase production.

THE LATEST SOLUTION developed for the problem of upgrading liquid hydrocarbons from natural gas is illustrated in the Platformer installation owned by the South Hampton Company, located near Silsbee, Texas, in the South Hampton oil field. This operation is one of the few but growing instances where a standard catalytic reformer has been installed apart from a refinery. This Platformer, of 700 bpsd reactor charge capacity, is upgrading a natural gas condensate boiling between 115 and 400 F. to a stabilized plant product testing approximately 98 Research octane number with 3 ml. TEL per gallon. However, 98 octane is by no means the ultimate in quality which can be produced by this installation.

The entire process area of the South Hampton plant now occupies an area of less than 150 feet square. It is adjacent to one of the modern cycling plants serving the South Hampton field and its charge stock consists of a portion of the cycling plant's production of hydrocarbons boiling in the gasoline distillation range.

A major addition is already being built—started less than seven months from the time that operations commenced last July. This expansion involves prefractionation facilities, which the original installation did not have, to permit the charging of a 200 to 400 F. boiling range cut to the Platformer reactors and the segregation of an isopentane fraction for separate sale as a high octane blending agent. The new fractionation facilities also will set the stage for the future possibility of adding isomerization to upgrade the normal C_5 and C_6 hydrocarbons. The immediate result of the new facilities, however, will be confined to increasing the overall volume of plant production, without alterations to the Platformer.

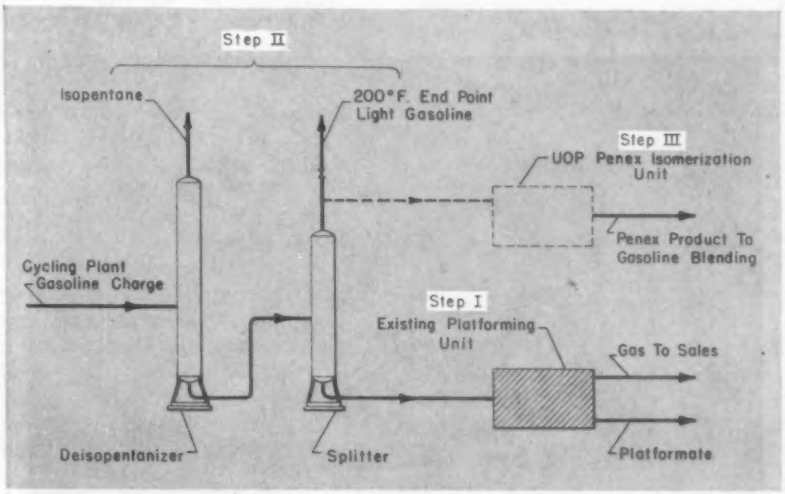


FIGURE 1—To increase charge to plant, South Hampton is adding prefractionation facilities (Step 2) to existing Platformer (Step 1).

The South Hampton Company was organized for the express purpose of building and running a catalytic reformer to upgrade cycling plant gasoline. The company also was its own prime contractor in the erection of the unit, doing all the detailed engineering from designs furnished by Universal Oil Products Company. It is following the same practice in installing the new facilities.

The practicability of field upgrading to produce larger quantities of catalytically reformed motor fuels from well condensates is amply demonstrated in the operation of the South Hampton Platformer itself. It was designed for the minimum of attended operation. Elaborate shut down and alarm systems protect the unit and summon one of the two operators from anywhere on the property in the event of an emergency. Most of the time the unit runs itself.

Process Description. The Platformer draws its charge directly from the debutanized natural gasoline storage tanks on the premises of the adjacent cycling plant. This latter installation, operated by a major oil company as agent for itself and the other owners, also furnishes various utilities to the South Hampton plant, including a portion of the process water, steam, fuel gas, yard air and water for the fire fighting loop.

Facilities on the premises of the South Hampton Company include the Platforming unit, instrument air com-

South Hampton Steps Up Platformer . . .

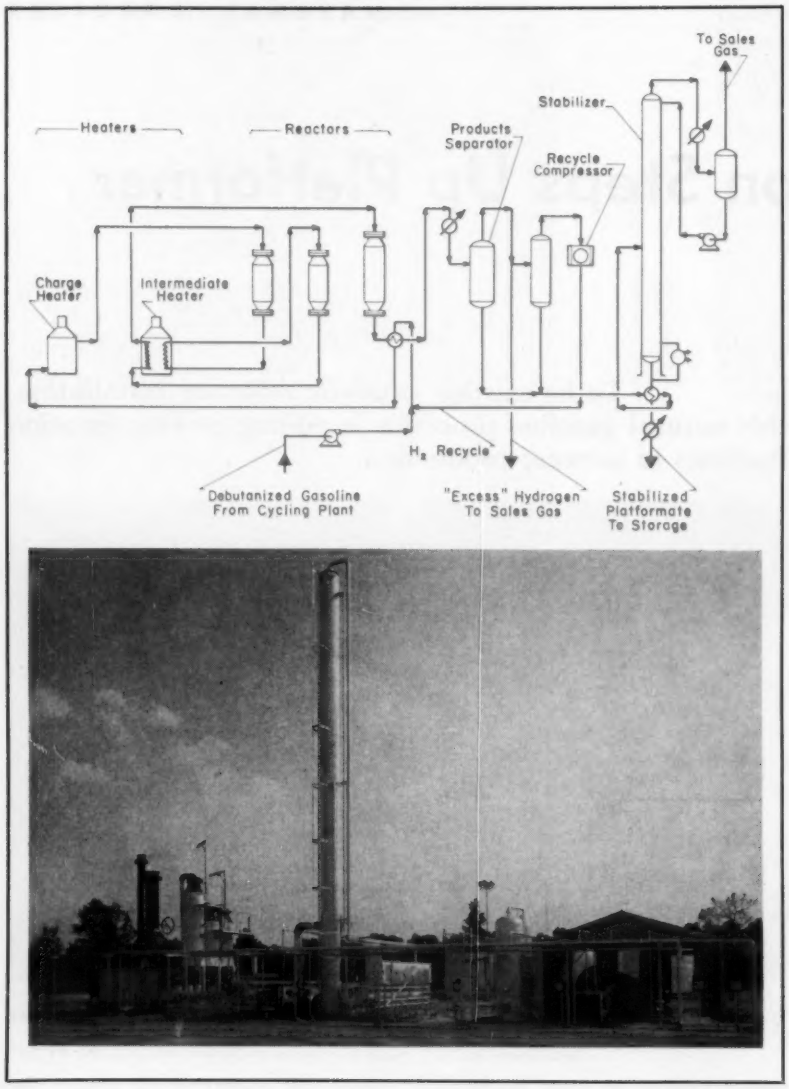


FIGURE 2—Flow scheme for existing Platformer: Standard design for most part. Entire process area occupies only 150 square feet.

pressor, a water well, and a cooling tower. A gas engine furnishes the motive power for both the charge pump and the recycle gas compressor. A clutch permits the charge pump to be shut down without affecting the gas engine and the recycle gas compressor. This safety feature prevents the inadvertent admission of charge to the reactors in the absence of hydrogen.

One of the unusual features of the South Hampton unit is that it does not have a separate charge tank or feed surge drum. The charge pump takes suction from one of several finished product tanks located within the cycling plant. One of these tanks, when full, will furnish enough feed for the Platformer to run at least three days.

This arrangement makes it possible for South Hampton to obtain a relatively constant composition feed stock independent of the fluctuations in production volume which normally are encountered in natural gasoline and cycling plant operations. If the Platformer were tied directly to the gasoline run-down line of the cycling plant, there might be daily, or hourly, fluctuations in volume for which to compensate in operating the Platformer, thus requiring more operator supervision. Similarly, it is not necessary for the operators of the cycling plant to be concerned with controlling their operations to suit Platforming requirements.

The process flow for the Platformer is shown in Figure 2. The unit is for the most part of standard design. The feed is mixed with hydrogen recycle, preheated by exchange against reactor effluent and then flows via the charge heater to the first reactor. The subsequent flow also is standard for Platforming, with the final product being stabilized to the desired vapor pressure. The "excess" or net hydrogen, plus the stabilizer overhead make gas, is returned to the cycling plant for inclusion with that plant's sales gas.

97.5% Yield. The reformate is combined with the gasoline produced by another nearby cycling plant at an independently operated tetraethyl lead blending plant in the area. There, by suitable blending, both a leaded regular and a leaded premium grade gasoline are produced. These finished products are then turned over to a brokerage agency for sale.

Typical inspections of the feed stock now being charged and the resulting reformate are shown in Table 1. It will be noted that the product tests 86.5 Research octane number clear which, with 3 ml. TEL per gallon, is rated at 97.5. This indicates that the current operation may not be considered a high severity one, and it emphasizes the high lead susceptibility of the product.

TABLE 1

Inspection of Natural Gasoline Feed and Reformate Product

	Feed	Product
Gravity, °API	65.7	63.5
ASTM Distillation, °F:		
IBP	116	94
10 percent	141	115
50 percent	210	166
90 percent	332	291
E.P.	398	392
Recovery, percent	99.0	98.0
Color, Saybolt	+30	.....
Vapor Pressure, Reid, psig	6.7	9.5
Yield, Vol.—percent on charge	.....	89.5
Octane Rating, Research:		
Clear	57.0	86.5
With 3 ml. TEL/gal.	.....	97.5
Hydrocarbon Type Analysis of Depentanized Feed:		
Paraffins	58	
Naphthenes	35	
Aromatics	7	

Operation Almost Unattended. The South Hampton Platformer was designed for virtually automatic operation. Two men who have other duties in the immediate area "look in" on the unit on a scheduled basis.

uled basis. In order to make such an operation practical, an elaborate system of shutdown devices and alarms has been installed.

The alarm system is actuated by either high or low liquid level in the products separator and by excessively low instrument air pressure. A contact in the hydrogen recycle gas flow meter also sets off an alarm to indicate that the hydrogen circulation is reaching a minimum flow. This, for instance, might be the result of engine drive failure on the recycle compressor or failure within the compressor itself. The temperature recorder-controllers on the furnace coil outlets are equipped with a mechanism which, either as the result of excessively high temperature or a failure within the instrument itself, will sound an alarm. This provision is intended to protect the catalyst from excessively high temperature and also to protect the heaters in the event of a control instrument failure.

The alarms sound in the control room and in the operators' residences.

There are five shutdown devices which immediately take the plant off the line in the event of emergencies by simultaneously grounding out the magneto of the gas engine driving the charge pump and the recycle compressor, and closing a valve in the gas supply lines to the heaters to shut off all fuel. The engine must be restarted manually, and the gas valve must be hand-reset. This shutdown system also might be actuated in the event of an emergency—such as a fire—by manually striking emergency shutdown switches in strategic locations throughout the South Hampton unit.

The following emergencies will shut down the plant without operator action: a high stack temperature in either heater, abnormally low or high flow of hydrogen recycle gas, and excessively high liquid level in the recycle compressor suction drum. Excessively high temperature in the inlet line to the products separator, indicative of a failure in the cooling water system, also will take the Platformer off stream.

A second, independent shutdown system has been installed in the electrical circuits of the plant to protect the Platformer against a power failure which lasts for more than a few seconds. The cooling water pumps and the stabilizer reflux pump are electrically-driven. The device is battery-operated, and grounds out the magneto on the gas engine as well as shuts off the gas to both heaters.

Economics. Investment costs for Platforming units will vary from $150 to $350 per barrel of fresh feed, depending on size, type of feed pretreatment, severity, local construction conditions, etc. The high of the range, of course applies to the smaller units. Typical operating costs for Platforming units in the 1000-bpsd size range, or smaller, will run about 1-cent per gallon of feed or less. This figure includes labor, utilities, catalyst, royalty, laboratory, maintenance, property taxes, insurance and supervision; it does not include amortization, federal income taxes or interest charges.

Operating costs will vary with severity of the Platforming operation, degree of integration with adjacent equipment, size of the unit, and unit prices prevailing locally for utilities and labor.

Current and Future Expansion. The original design of the Platforming unit of South Hampton called for charging 700-bpsd of full boiling range, detutanized cycling plant gasoline, of the composition shown in Table 1, to the Platformer reactor section. In order to increase the total raw charge capacity of the plant as a whole to 1200-bpsd, and to improve both refinery netback and gasoline volatility, Step II of Figure 1 has been undertaken and will be completed shortly.

The facilities being added, a feed splitter and a deisopentanizer, will fit into the flow scheme ahead of the existing Platformer, as shown in Figure 2. They will permit the production for the first time of a new product for South Hampton, high purity isopentane. This will be sold separately or partly used for in-plant blending. Also, the 225 F. end point gasoline will be excluded from the Platformer charge whereas, originally, there was no prefractionation.

The net effect for the present of these new facilities will permit charging 700-bpsd of a 200-400 F. fraction to the Platformer reactor section, which cut derives the most beneficial results from Platforming. The light gasoline thus excluded from Platforming will have an octane rating of approximately 88 Research with 3 ml. of TEL per gallon and is, therefore, suitable for blending into motor gasoline at the present time. When the new facilities are placed in service, the South Hampton plant will still be able to produce a 98 Research octane leaded Premium grade gasoline and a 92 octane Regular grade by suitably dividing the 88 octane light gasoline between the two grades of motor fuel during blending.

It doubtless will be necessary to increase the severity of Platforming over that currently practiced, in order to compensate for the former octane contribution of isopentane which will be removed. The amount of isopentane taken off the deisopentanizer also may be adjusted downward from the maximum represented by the total isopentane content of the raw feed, thereby reducing the severity of Platforming to whatever level is desired. Possibly the octane rating of the clear reformate will be increased from the existing 86.5 to the order of 92-95 Research, corresponding to 100-101 octane leaded. In short-time tests which were run experimentally during initial operations of the unit, the Platformer clearly showed that these high octane levels are readily obtainable by appropriate changes in operating conditions.

When future octane requirements demand it, Step III of Figure 2 probably will be undertaken. This plan calls for the isomerization of the light gasoline (splitter overhead) in a UOP Penex unit for additional octane improvement, and possibly additional isopentane production as well. Depending on the size of the Penex unit ultimately chosen, it will be possible to increase the Research octane rating of this stream to as high as 98 with 3 ml. of lead. A minimum sized unit would result in an octane rating of the order of 94 with 3 cc's of lead.

# #

About the Author

JOHN BREAKER received his B.S. degree in petroleum engineering from the University of Oklahoma in 1940. He spent one year with Coronada Corp. as a plant operator, then in 1941 he joined The Gasoline Plant Construction Corp., Houston where he remained until 1955 when he formed the South Hampton Co. in Houston.

a Special Report

NATURAL GASOLINE

Approaching Problems of Cooling Water Corrosion

Only two variables are really important—effect of conductivity and effect of inhibitor on anodic and cathodic areas.

M. C. Forbes
Aquatrol, Inc., Houston

THE TWO MAJOR factors that must be considered in cooling water corrosion inhibition are (1) the effect of the conductivity (TDS) of the cooling water and (2) the effect of the inhibitor on the cathodic and anodic areas of the corroding material. Changes in oxygen content of the water or changes in pH appear to have less effect than has been usually thought unless these variables are changed sufficiently to alter the basic nature of the corrosion reaction. These conclusions are based on a generalized equation for cooling water corrosion (see box for derivation).

What's Needed. Any inhibitor that is going to materially reduce the pitting rate must (1) change the fundamental corrosion reaction to one that will cause less metal loss or (2) it must lower the conductivity of the water or (3) it must operate to change the size of the electrolytically active areas in a desirable manner.

The first condition is frequently met in systems that can be kept free of recurring aeration by the use of mechanical deaeration equipment or by the use of chemical oxygen scavengers such as sodium sulfite or hydrazine.

For the second condition there is little of economic significance that can be done about the control of corrosion by lowering the specific conductivity of the cooling water. But the most obvious way to lower the specific concentration of salts is by constantly withdrawing some of the concentrated cooling water and adding an equal quantity of fresh make-up water. The drawbacks to this procedure are (1) it requires excessive water and (2) it causes losses of cooling water treatment chemicals.

By taking a specific example where costs of chemicals and water are known and assuming that the dollar losses due to corrosion are directly proportional to the weight loss of the test coupons, it has been shown that a minimum occurs in the total cost (water plus chemicals) versus concentration ratio (TDS in basin water/TDS in make-up water) at concentration ratios of 5-8.

Inhibitors Used. It's the third condition at which commercial inhibitors are aimed—controlling the sizes of the electrolytically active areas of the corroding system. Since the anode area is always identifiable by the loss of metal and the proximity of corrosion products, it is normal that historically this was the first area to be attacked in efforts to control corrosion. But most of the material used to suppress anodic corrosion had to be used in uneconomically large quantities or penetration rates would be sharply increased even though the total amount of corrosion was reduced. The equation developed here shows why this should be so since (all other factors being held constant) the total corrosion rate is proportional to the sum of the anode and cathode areas Equation (8) and the average pit depth is proportional to the sum of the anode and cathode areas divided by the anode area (Equation 9).

$$\text{Total Corrosion} = K_2 (A_a + A_c) + K_4 \quad (8)$$

$$\text{Avg. Pit Depth} = K_2 \frac{(A_a + A_c)}{A_a} + K_4 \quad (9)$$

The most successful anode inhibitor is the chromate ion which in high concentration (500-1000 ppm) is a very satisfactory inhibitor for open cooling water systems. Such large quantities of chromate are expensive, this material adds color to the water and it is toxic to animal life in these concentrations. At lower concentrations, severe pitting very frequently takes place. Efforts have been made to overcome these bad effects by adding a second anodic inhibitor such as phosphate which does not add to the color or toxicity. Double-anodic treatments of this type have not been entirely successful since it is not possible to add enough phosphate to make up for the lack of chromate without causing scale to form from the precipitation of calcium phos-

Text Continued on Page 216

About the Author

M. C. FORBES has been president of Aquatrol, Inc., in Houston since 1949. He also serves the company as technical director. Forbes previously was water engineer for Celanese Corp. of America at Bishop, Texas, and before that was research chemist with Pan American Refining Corp. at Texas City. He is a graduate in industrial chemistry from the University of Kentucky and holds an M.S. degree in chemistry from Ohio State University.

How the Equation Was Derived

FIGURE 1 shows an idealized picture of an iron surface corroding in cooling water. In this derivation, it is assumed that cooling water corrosion is limited to a single mechanism that operates roughly in the pH range of 5-9 in the presence of an adequate supply of oxygen. Conditions of very high or low pH or limited oxygen supply rarely occur over extended periods of time in open cooling systems.

There are a number of oxidation reduction half cell reactions that can cause corrosion, but the ones shown in Figure 1 are those most likely to occur under the conditions set up. The reactions shown for each half cell are assumed to occur in separate portions of the system connected to each other electrolytically through the cooling water and metallically through the pipe or other structures which are corroding. In the complete oxidation reduction equation, the Fe^{++} and the OH^- ions are not shown reacting with each other to form $Fe(OH)_2$ since it is not necessary for reaction to occur and in certain types of inhibitors, it is known not to occur.

Only a brief derivation of the equation will be given. The various relationships employed are given in the order that they are used. In general, the expression equated to each independent variable is substituted in the next formula where that variable then becomes the dependent variable. Where various physical chemical terms require a conventional definition, they are the conventions used in Lewis and Randall's "Thermodynamics" and Glasstone's "Textbook of Physical Chemistry."

Certain operational and dimensional constants have been treated loosely in this derivation since it is intended only for studying differential effects.

Equation (1) is the standard equilibrium constant for the corrosion reaction as it is believed by many to occur. The values of Fe° and H_2O are considered constant and therefore are included in the value of K the equilibrium constant. Equation (2) is the standard Nernst equation except that the term $[OH^-]^2$ value has been equated to the pH value of the cooling water by means of K_w, the equilibrium constant for water. According to Latimer's "Oxidation Potentials," the value for E° for the reaction shown is approximately 1.28 volts. Equations (3) and (4) convert the EMF of the cell to the corrosion current by the use of the specific conductivity of the solution, k, the distance between the electrodes L, and the electrolytically active area of the anode A_a plus the cathode area A_c. Equation (5) converts the corrosion current to corrosion rate by using Faraday's constant F and the gram equivalent weight ε. The corrosion rate in terms of weight is converted to volume per unit time by the use of the density, in Equation (6). Equation (7) transforms the volume corrosion rate to the penetration rate or average pit depth by dividing the volume rate by the area of the corroding surface (anode area A_a). If the total area of the specimen ($A_a + A_c$ + inert area) is used in place of the anode area A_a the final equation will give the average penetration rate as most often used in reporting results from weight loss studies on strips or nipples.

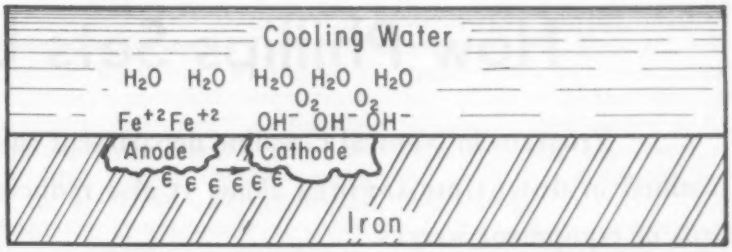


FIGURE 1—Idealized picture of an iron surface corroding in cooling water.

This equation, while far from being the final answer to all practical problems, does point up some interesting features. First, there are several factors in the equation over which we have no control once the system is defined as being the corrosion of iron or steel in a dilute salt solution (less than 500 epm) saturated with oxygen whose pH lies between 5 and 9. The factors that remain constant or nearly so are F, n, R, K_w, ε and E° which are natural constants of the system. L, the distance between the electrically active areas is not likely to vary widely since it will be as small as possible because of the decrease in conductivity with distance between the electrodes. T will of course be a constant for any given set of operating conditions.

The oxygen partial pressure, pO_2, pH and Fe^{++} concentrations can have little effect on the pitting rate since the function $\frac{RT}{nF}$ at 25 C. has a value of approximately 0.0295 which will tend to minimize even large changes in the values of these variables. It should be pointed out here that the pH can have a much larger effect on the corrosion rate than is indicated by this equation since pH values near the extremes of the range in which this equation applies (5-9) can markedly effect the specific conductivity of the solution and thus have more effect on the pitting rate than its normal contribution in changing the EMF of the corrosion cell would indicate. Below pH 4.5, the reactions set forth here do not usually apply, but direct displacement of hydrogen by the Fe° takes place with a marked increase in corrosion rate.

This leads us to the conclusion that the most important variables as shown by this equation then are the areas of the anode and the cathode and the specific conductivity of the solution.

For simplification, several important factors in the corrosion phenomena are left out or are covered by the factors given in an indirect way. They are the effect of mechanical conditions (such as layers of sediment or slime on the metal), the velocity of the solution past the metal surface, bending, vibration, and the effect of various ions on pitting rate.

$$K = \frac{[Fe^{++}]\,[OH^-]^2}{p{o_2}^{1/2}} \tag{1}$$

$$E = E^\circ + \frac{RT}{nF}\ln k = E^\circ + \frac{RT}{nF}\left(\ln \frac{pO_2^{1/2}}{[Fe^{+2}]\,K_w^{\,2}} - 2pH\right) \tag{2}$$

$$R' = \frac{L}{k\,(A_a + A_c)} \tag{3}$$

$$I = \frac{E}{R} = \frac{k\,(A_a + A_c)}{L}\left[E^\circ + \frac{RT}{nF}\left(\ln \frac{pO_2^{1/2}}{[Fe^{+2}]\,K_w^{\,2}} - 2pH\right)\right] \tag{4}$$

$$\frac{W}{t} = \frac{\varepsilon}{F} \cdot I = \frac{\varepsilon k\,(A_a + A_c)}{LF}\left[E^\circ + \frac{RT}{nF}\left(\ln \frac{pO_2^{1/2}}{[Fe^{+2}]\,K_w^{\,2}} - 2pH\right)\right] \tag{5}$$

$$\frac{V}{t} = \frac{1}{\rho} \cdot \frac{W}{t} = \frac{\varepsilon k\,(A_a + A_c)}{\rho LF}\left[E^\circ + \frac{RT}{nF}\left(\ln \frac{pO_2^{1/2}}{[Fe^{+2}]\,K_w^{\,2}} - 2pH\right)\right] \tag{6}$$

$$P = \frac{1}{A_a} \cdot \frac{V}{t} = \frac{\varepsilon k\,(A_a + A_c)}{\rho LF\,A_a}\left[E^\circ + \frac{RT}{nF}\left(\ln \frac{pO_2^{1/2}}{[Fe^{+2}]\,K_w^{\,2}} - 2pH\right)\right] \tag{7}$$

a Special Report

NATURAL GASOLINE

How Phillips Sets Up Preventive

Program in Natural Gasoline department can be justified in downtime savings alone. It also reduces hazards of equipment wrecks.

J. E. Mallow
Phillips Petroleum Company
Bartlesville

THE NATURAL GASOLINE department of Phillips Petroleum Company is thoroughly sold on the advantages of a preventive maintenance program. Even if the program did not reduce maintenance costs, it can be justified on the reduction in downtime. The program also reduces the hazard of equipment wrecks (which occur more frequently when only breakdown maintenance is practiced).

This department of Phillips operates approximately 700 gas engine compressor and generator units varying in size from 200 to 2200 horsepower, and approximately 3000 pumps and turbines. The maintenance of these and hundreds of other mechanical units accounts for an appreciable portion of the expense of producing natural gasoline.

The maintenance of mechanical equipment can be viewed as falling in two categories—breakdown maintenance and preventive maintenance. In breakdown maintenance, as the designation implies, it is the practice to operate equipment until partial or complete failure occurs before any type of repair is attempted. This type of operation usually results in high maintenance costs and production losses, compared to the practice of preventive maintenance.

Preventive maintenance can be defined as a maintenance program for eliminating or confining the action of destructive forces to avoid breakdown and extensive damage and extensive production losses. A preventive maintenance program must provide for scheduled repair and adjustment of equipment. Phillips has found that preventive maintenance permits the most economical repair and efficient operation of mechanical equipment. In establishing such a program, attention must be given to such factors as:

- Plant planning and design
- Installation of equipment
- Training maintenance personnel
- Use of machine shops
- Lubrication
- Scheduling repair work
- Accumulation of maintenance cost records.

Plant Planning and Design. In the planning of a new installation a number of items which will affect future maintenance costs are given consideration. Of primary importance is the choice of the proper equipment. Mechanical equipment is not purchased solely on a price basis. All equipment designs on which quotations are received are thoroughly analyzed, not only for defects in design which may result in excessive repair costs, but also for accessibility for anticipated repair work. Consideration of these factors often leads to the conclusion that the most expensive piece of equipment will justify its higher first cost by requiring lower repair costs during its life.

Cooling systems and fuels must be considered in the planning stage. Many operators have learned through experience the costly effects on maintenance of inadequate cooling for engines and compressors, and improper fuel for engines. Phillips uses closed cooling systems with ample circulation and cooling surface so that cooling temperatures through operating equipment will not rise more than 10 degrees, and temperature levels will be held within reasonable limits. Sweet gas fuel with a Btu value of from 1000 to 1200 is provided.

Maintenance is given consideration in providing buildings to house mechanical equipment. Adequate height and width of buildings is specified. All buildings housing large engines and compressors are equipped with a traveling beam which carries both a high capacity hoist and a smaller air hoist. The smaller air hoist is used for such items as cylinder heads and pistons and, being much faster than the large hoist, expedites repair work and permits a minimum of downtime.

Careful attention is given to the location of all piping connected to mechanical equipment to see that it will offer a minimum of interference with equipment maintenance. Piping systems on compressor intakes, and piping in fuel and air systems to power cylinders on engines, are designed to minimize the entrance of dust and liquids and other foreign particles to the cylinders. Particular attention is given to the cleanliness of lube oil systems. Heavy copper tubing with silver soldered joints is used for lube oil lines. This minimizes damage to working parts caused by welding slag or pipe scale frequently found in steel pipe systems.

Experience has proved that good housekeeping and good equipment maintenance usually go hand in hand, therefore mechanical installations, particularly engine and compressor equipment, are designed to permit good housekeeping and to present a neat and uncluttered appearance. Engines and compressors and building interiors are painted in harmonious colors. Colored concrete is used for floors and the floors are

Maintenance

troweled to a finish which will permit waxing.

Specifications for a mechanical installation include adequate tools. Maintenance crews are equipped with inside and outside michrometers, calipers, dial indicator, distortion gages, torque wrenches, air wrenches, and numerous special and common tools.

Installation. Experienced mechanical personnel are assigned to an installation job to make certain that the equipment is installed properly. Pumps, turbines, and such auxiliary equipment, are checked with instruments for proper alignment with the driver or driven units. Great care is taken to minimize strains transmitted by connecting piping.

Great care is exercised in grouting large engines and compressors. To insure a good bond between the grout and the foundation, the tops of foundation blocks are sandblasted to remove any laitance which may accumulate.

To prevent excessive bearing difficulties or shaft breakage, the engine is carefully checked for level and alignment after it is placed on the foundation. Engines are not permitted to be grouted which have more than .001 inch distortion in the crankshaft and, if at all possible, this is held to even lower limits. All power and compressor pistons are removed from the cylinders and each individual cylinder and piston is measured with micrometers. The purpose of this is to obtain a record of the condition of these items at the time the equipment is placed in operation. At times it has been found that engines were damaged during the factory test without the manufacturer's knowledge. Compressor piston rods are checked to make sure the piston will run true in the cylinder and not cause excessive cylinder wear. Crankcases and oil coolers are thoroughly cleaned so that bearings and shafts are not likely to be damaged by steel cuttings, rust or dirt. In several instances steel cuttings and rust, which would have seriously damaged crankshafts, have been found in oil coolers.

Training of Personnel. The Natural Gasoline department is geographically divided into three districts, each of which includes from 9 to 15 plants. Training of personnel in these districts has been an important phase of the preventive maintenance program for approximately 15 years. Personnel to fill the maintenance supervisory positions in all of the installations, either new or old, are given thorough maintenance training. In each district there is a mechanical maintenance superintendent an assistant, machine shop inspector, foreman and a repair crew, who are in addition to the regular plant maintenance personnel. Personnel for these repair crews are selected from plant operating and maintenance crews in the districts. Mechanical aptitude tests, as well as supervisory tests, are used in making selections. The training of these men includes study of specially prepared manuals on the various types and makes of equipment, classroom instruction and on-the-job repair of mechanical equipment under the supervision of a trained foreman. Classroom instruction includes some basic theory on the various types of equipment, proper operating temperatures, speeds, fuel pressures, timing and safety, as well as numerous other items important to the equipment. Teaching stresses the detrimental effects of misalignment, overloads, unbalanced initial pressures in power cylinders, oil leaks, excessive lubrication, excessive clearances on bearings, and improper torque on bolts. Indicator tests are conducted on low speed reciprocating equipment so that the trainees will have a vivid picture of the results of leaking compressor valves, bad piston rings, detonation, and improper timing.

To make the program work, these factors are considered:

- ✓ **Plant planning and design**
- ✓ **Installation of equipment.**
- ✓ **Training of personnel**
- ✓ **Use of machine shops**
- ✓ **Lubrication**
- ✓ **Schedule of repair work**
- ✓ **Maintenance of cost records**

In the on-the-job training, units of mechanical equipment in need of repair are completely disassembled, measured for wear, and checked for fatigue cracks or any other unsatisfactory conditions. During this training phase, trainees learn how to apply tolerances for wear learned in the classroom and gain judgment in determining when worn parts should be re-machined or discarded. As instances may be revealed when equipment is disassembled, improper maintenance practiced in the past is pointed out to trainees.

After the equipment is disassembled, any parts in need of repairs are sent to a precision machine shop for reconditioning. As soon as the machine work is finished the men reassemble the equipment under the supervision of the foreman who checks the assembly work and provides on-the-job instruction on alignment, running clearances, and timing of ignition, fuel and air. At the completion of the assembly, the trainees start the equipment and observe its operation to insure there will not be any mechanical difficulty experienced as a result of faulty assembly.

The trainees are given training of this nature for periods of from 1 to 2 years, depending upon the individual's ability, as well as opportunities for advancement into maintenance supervisory positions in plant operations. During this period they are again tested to determine their progress in the training program. As the need arises for a maintenance supervisor in the plants, the trainee who is best qualified is promoted to the plant maintenance supervisory position.

Use of Machine Shops. It has also been found that much can be accomplished in preventive maintenance by careful inspection and control of work performed in machine shops. The Gasoline department does not

attempt to maintain company owned machine shops to handle all of the machine work required on mechanical equipment. A small shop is maintained in each district to handle small routine work but the major portion of the heavier work is handled in outside machine shops which are carefully selected on the basis of their ability to produce precision machine work.

A machine shop inspector is located in each of these shops to inspect all equipment received and to determine the actual repairs required. Occasionally it is determined it would be more economical to discard a particular part and either buy or make a new one. All iron castings for cylinders and pistons are checked for Brinell hardness to determine if they meet the quality of cast iron which has been set up as a standard. All finished machine work is inspected to determine if it meets the established machine shop tolerances.

Previous to the use of an inspector in the shops it was often found that more money was spent in the repair of an old part than would have been required to manufacture a new one. Quite frequently the finished machine work of various parts was not a great improvement over the condition of the parts at the time they were received in the shops. In other instances, repairs of an unwise nature were performed, such as welding of steel parts without subsequent normalizing, which could and often did result in serious damage to the equipment after it was placed in operation. Improvement in the quality of machine work has been obtained through the use of inspectors and has lengthened the service life of machined parts with the result that machine shop costs have been reduced. Additionally, it has been found that experience as a machine shop inspector is valuable training for future assignments in the maintenance of mechanical equipment.

Lubrication. In recent years a reduction in lubrication has become an important phase of the preventive maintenance program. As equipment was disassembled or received in machine shops considerable evidence of over-lubrication was found. It was quite obvious that if lubrication could be reduced there would actually be less wear and damage to cylinders, pistons, and rings. Through a reduction in carbon formation, the period between overhauls could be extended with the result that labor would be reduced and equipment would be on the line a greater percentage of the time.

On large engines and compressors the average oil consumption had been approximately 3000 bhp hours per gallon. A figure of 8000 bhp hours per gallon was set as a goal to be attained. The goal has not been reached in all installations, but in a number it has been exceeded and the effort is paying dividends in reduced maintenance costs. Piston ring wear and replacement has been reduced. Wear rates on cylinders and pistons have not increased since there is still ample oil film on the cylinder wall. As a result of the reduction in ring wear and carbon formation, it has been possible to extend the schedule periods between overhauls to twice the previous length.

Scheduling Preventive Maintenance. Preventive maintenance schedules covering maintenance of engines and compressors have been in use for a number of years. These schedules cover items of preventive maintenance which are to be performed weekly, monthly, semi-annually, or annually. Records are maintained which show the progress of individual plants in following the schedules.

At the time these preventive maintenance schedules were first proposed, opinions were expressed that placing these in effect would result in considerable extra time down, as well as cost. It was also the opinion of some that more manpower would be required. In actual practice it has not resulted in any increase in time down and neither has it been necessary to add personnel in order to carry out the schedules. Previously, breakdowns of various natures were not uncommon and since they could not be anticipated material was not always on hand to make the repairs, with the result that the equipment was often down for long periods of time and the repairs were excessive in cost.

During the period that scheduled preventive maintenance has been practiced, breakdowns have been minimized and have become the unusual rather than the common occurrence. Down time for repairs has not increased but has decreased to some extent. On the more modern engines and compressors the time down for repairs is in general less than 1 percent.

Maintenance of Cost Records. Previous to the initiation of preventive maintenance schedules, a procedure was set up whereby all costs of maintenance material and labor would be accumulated by the Comptrollers department. An accounting number was assigned to each group of each particular make and type of engine and maintenance personnel were instructed to charge labor and material accordingly. Since the accounting procedure provided a record of cost before the initiation of preventive maintenance schedules, as well as during the time these have been in effect, it has been possible to determine the results of preventive maintenance in terms of actual dollars. Year by year there has been a continued reduction in the maintenance cost. ##

About the Author

J. E. MALLOW received his B.S. degree in 1932 from North Texas State College at Denton. In 1933 he joined Phillips Petroleum Co. in the Natural Gasoline department. Since that time he has served as operator engines, plant engine foreman, machine shop inspector, district mechanical maintenace superintendent, assistant departmental mechanical maintenance superintendent, and since 1953 as mechanical maintenance superintendent for the Natural Gasoline department.

New Concept in Polymer Chemistry

You must know these terms—Atactic, Isotactic, Syndiotactic—if you are to understand how stereochemistry affects polymers.

Lewis F. Hatch
The University of Austin
Austin

IT HAS BEEN SAID that the petrochemical industry would rather be caught with its plants down than to be without the latest in petrochemicals. Today the latest is highly crystalline polymers. The tumult and shouting over low-pressure polyethylene are being converted into plant construction. However, crystalline polypropylene is enveloped in a pregnant silence, but it is known that approximately 40 firms are actively interested in its development.

For a hundred years chemists have tried in vain to duplicate nature in the polymerization of isoperene to a true synthetic (artificial) rubber. This type of crystalline rubber is now undergoing extensive testing by several companies.

This revolution in polymer chemistry has been made possible by a new concept in the catalysis of vinyl polymerization. Along with these new developments have come new terms. To understand these terms it is necessary to have at least a nodding acquaintance with the elements of stereochemistry.

STEREOCHEMISTRY

Stereoisomers are difficult to represent in two dimensions for they possess the same molecular and structural formulas but differ in the three-dimensional space arrangement of the atoms or groups within the molecule. The two common types of stereoisomerism are *cis-trans isomerism* (geometrical isomerism) and *optical isomerism*.

Cis-trans isomerism owes its existence to the rigidity of configuration imposed on the molecule by a carbon-carbon double bond and is related to the position of the substituents in space. The designation *cis* is used when like atoms or groups are on the same side and *trans* when they are on opposite sides (Figure 1). This designation is meaningless when three or four different groups are involved. Like groups on the same carbon atom preclude the possibility of *cis-trans* isomerism.

Many different olefins exist as *cis-trans* isomers, but their properties are sufficiently similar so that usually no differentiation is made between the two. A familiar example is the two 2-butenes (β-butylenes).

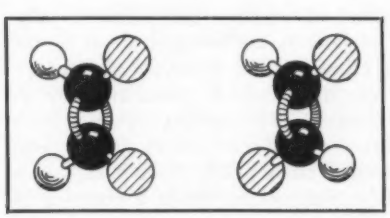


FIGURE 1—Ball and peg models of *cis*-1,2-dichloroethene (*cis*-di-chloroethylene) and *trans*-1,2-dichloroethene (*trans*-di-chloroethylene).

cis-2-Butene
b.p. 3.6 C.

trans-2-Butene
b.p. 0.9 C.

Isomers of this type generally react with the same kinds of reagents but at different rates.

Optical isomerism is a subtle form which is of considerable importance in natural products. Most optically active compounds are characterized by having at least one *asymmetric* carbon atom—a carbon atom with four different groups attached to it. If there is one asymmetric carbon, there are two isomers possible (Figure 2). One molecule is the mirror image of the other; yet they are not superimposable regardless of how the molecules may be rotated, a situation similar to that which one has with his right and left hand. Pairs of compounds of this type are called enantiomorphs.

Simple enantiomorphs have the same chemical and physical properties; they differ only in their optical properties. One form rotates polarized light to the right (dextro, *d*) and the other to the left (levo, *l*). An equimolar mixture of *d* and *l* isomers shows no optical activity and such mixtures are called *racemic mixtures*. This type of mixture is nearly always formed when optically active compounds are synthesized by man, but nature usually synthesizes one form only with resulting optical activity.

ATACTIC POLYMERS

Until recently the polymerization of dienes (isoprene [$CH_2 = C(CH_3)CH = CH_2$], for example) gave polymers oriented randomly *cis-trans* around their double bonds and containing a fairly high percentage of 1,2-addition with pendant vinyl side groups. This irregular structure gives a polymer which does not have great mechanical strength. These polymers are called *atactic*, and they are not stereospecific.

Vinyl monomers such as propylene ($CH_2 = CHCH_3$),

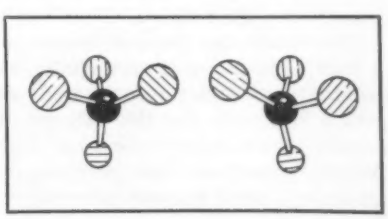
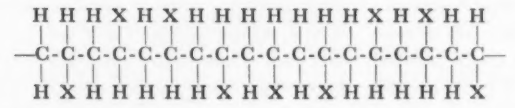


FIGURE 2—Ball and peg models of a pair of simple optical isomers.

styrene ($CH_2=CHC_6H_5$), vinyl chloride ($CH_2=CHCl$) and acrylonitrile ($CH_2=CHCN$) polymerize to yield polymers with every other carbon atom being asymmetric. The polymers produced by conventional catalysts have a perfectly random distribution of *d* and *l* configuration around these carbon atoms.

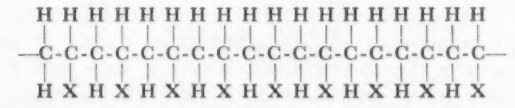


This type of polymer is also called *atactic*.

STEREOSPECIFIC POLYMERS

It is now possible to produce vinyl polymers in which all of the asymmetric carbon atoms are in the *d* configuration or all are in the *l* configuration. They are called **isotactic polymers.** It is also possible to produce vinyl polymers in which the asymmetric carbon atoms are arranged in a regular alternation of the *d* and *l* configuration. These are called **syndiotactic polymers.**

Isotactic vinyl polymers



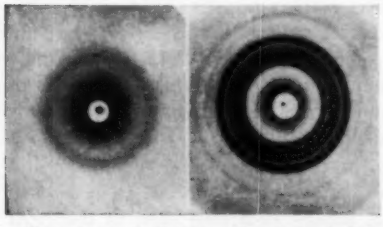
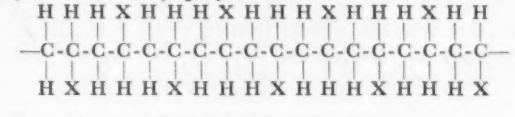


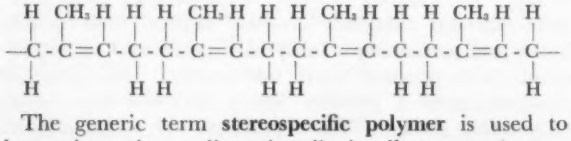
FIGURE 3—X-ray diagram of atactic polypropylene (left) and isotactic polypropylene (right).

(From Arthur V. Tobolsky, "Revolution in Polymer Chemistry," *American Scientist*, 45, 34 (1957).

Syndiotactic vinyl polymers



The polymerization of isoprene with the proper catalyst will give an all *cis* polymer.



The generic term **stereospecific polymer** is used to denote isotactic, syndiotactic, all *cis*, all *trans* and regularly alternating *cis-trans* polymers. They are ordered polymers, and this regularity of structure imparts unique properties to the polymer.

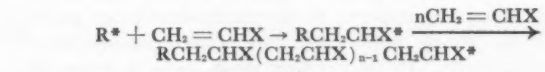
The outstanding physical property of isotactic polymers is their high degree of crystallinity. Because of the great regularity of structure of these polymers there is a greater tendency for the polymer chain to fit into a crystal lattice than is the case with atactic polymers. Atactic polystyrene and polypropylene are completely amorphous while isotactic polystyrene and polypropylene are highly crystalline. Atactic polypropylene gives an X-ray pattern typical of an amorphous solid while isotactic polypropylene shows the sharp rings characteristic of crystalline substances with random orientation of crystallite (Figure 3).

Not all isotactic polymers are crystalline, however. The degree of crystalline character is governed to some extent by the size of the side chain. Large side chains (the X group) will not permit the main polymer chains to fit into a crystal lattice in spite of the regularity of the structure. Conversely, an atactic polymer may be partially crystalline if the side chain or group is small enough to fit in a crystalline lattice in spite of an irregular configuration. Atactic polyvinyl chloride, polyvinyl alcohol and polyacrylonitrile are examples.

The outstanding physical property of a highly crystalline polymer is a higher modulus of rigidity than the corresponding atactic polymer. Atactic polypropylene is rubbery and of little commercial importance; isotactic polypropylene is a tough, rigid plastic with properties competitive with polyethylene.

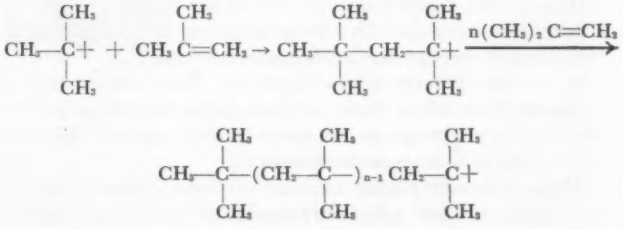
CATALYST

Traditionally and commercially vinyl polymerization is effected by a free radical mechanism in a homogeneous system. The free radicals are provided by the decomposition of a peroxide or other conventional free radical source. A free radical adds to a monomer to form another free radical which in turn adds to another monomer, thus initiating a chain reaction.



The chain growth is very rapid and is terminated by combination of a radical with another radical, an impurity or the wall of the container. Only a very small amount of initiator is required for this type of polymerization. The products are essentially noncrystalline (atactic).

Noncrystalline polymers also are formed by the use of either positive or negative ionic initiators. The polymerization of isobutylene using aluminum chloride at a low temperature in methyl chloride is an example of this type of polymerization.



The product of this carbonium ion initiated polymerization is butyl rubber.

Linear polymerization of ethylene and isotactic polymerization of vinyl monomers are brought about by the use of heterogeneous catalysts. The discovery of this type of polymerization was made nearly simultaneously in several different laboratories. The earliest reported work was that of Scheldkecht and co-workers (1947) who polymerized methyl vinyl ether ($CH_2=CHOCH_3$) to a stereospecific crystalline polymer by use of a complex of

boron trifluoride. At about the same time Karl Ziegler (Institute of Coal Research, Germany) and Guilio Natta (Milan Polytechnical Institute) were working with quite a different catalyst system. One version of the Ziegler catalyst is prepared by the reaction between titanium tetrachloride ($TiCl_4$) and an aluminum alkyl (AlR_3) in an inert solvent such as heptane or benzene. A finely divided precipitate is formed which is a catalyst for anionic polymerizations. The polymerization is also characterized by the mild conditions which may be used: room temperature and atmospheric pressure. This type of catalyst produces linear polymers from ethylene, stereospecific polymers from vinyl monomers and all *cis*-1,4-polyisoprene from isoprene. The use of titanium trichloride in place of the tetrachloride is reported to increase the yield of polypropylene from 35-45 to 85-95 percent.

Other solid catalysts have been developed. Standard Oil Company (Indiana) has patented the use of a nickel-charcoal catalyst and a molybdenum oxide on alumina catalyst. A metal hydride co-catalyst may be used to promote the reaction but it is not essential. Phillips Petroleum Company has patented an hexavalent chromium oxide on alumina catalyst. Apparently the valence state of the molybdenum and chromium catalysts is the key to their catalytic activity. Lithium metal is used by Firestone to synthesize all *cis*-1,4-polyisoprene.

The problem of who got there first with the most will enrich patent lawyers for years to come.

The intimate **reaction mechanism** is not clearly understood but must be related to the solid surfaces of the catalysts and their orienting effect. Natta believes that the stereospecific orientation of the monomer in the polymer occurs at the moment that it enters between the surface-polymer bond.

Metal Surface $M^+ - \overline{C}H_2 - CHX \rightarrow M^+ - (\overline{C}H_2CHX)_nCH_2 - CHX-$

H. N. Friedlander (Standard Oil Company [Indiana]) believes that the monomers are held in contact with the surface of the catalyst and the orientation of the polymer occurs because of this contact with the surface (Figure 4). The growing end of the chain may be a bound radical, anion or cation.

C. C. Price (University of Pennsylvania) has proposed a mechanism similar to that of Natta for the stereospecific polymerization of propylene oxide by ferric chloride complexes. This detailed mechanism appears in the Journal of the American Chemical Society (**78,** 690 [1956]).

The possibility of stereospecific polymers being produced by homogeneous ionic polymerization is at present in the rumor stage.

THE FUTURE

The future of low-pressure, highly crystalline **polyethylene** is almost here. The feverish planning and building of plants have been too thoroughly documented in all forms of communication to warrant further comments. It will be sufficient to note that the first commercial production of salable products was reported for December 31, 1956. It is estimated that by 1960 low-pressure polyethylene capacity will be between 400 and 600 million pounds per year. This represents 30 to 46 percent of the total U. S. polyethylene capacity.

Polypropylene is more of an enigma. Isotactic polypropylene is said to be directly competitive with low-pressure polyethylene, but the competition is several years away. It is as tough and rigid as low-pressure polyethylene without its waxy feel. It may be drawn into oriented fibers which have a higher tensile strength than nylon. Polypropylene can be molded into rigid and semirigid objects and extruded as film. The film is said to have greater clarity than polyethylene. It has higher molecular weights, higher melting points, greater heat resistance and more resistance to organic solvents than low-pressure polyethylene. Polypropylene may also be in competition with polystyrene.

Price-wise propylene at about 1 to 2 cents per pound is attractive compared to ethylene at about 5 cents per pound. A sharp increase in demand for propylene will undoubtedly cause the price of propylene to increase.

Cis-1,4-Polybutadiene has been produced using stereospecific polymerization catalysts. This type of rubber generates less heat than SBR rubber and is nearly as good as natural rubber in this respect. Its resilience is 10-15 percent better than styrene rubber and it performs better in cold weather. The *trans* polymer can be prepared by varying the conditions of polymerization. This polymer is a high softening resin with many potential applications.

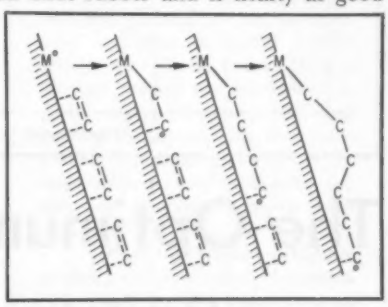


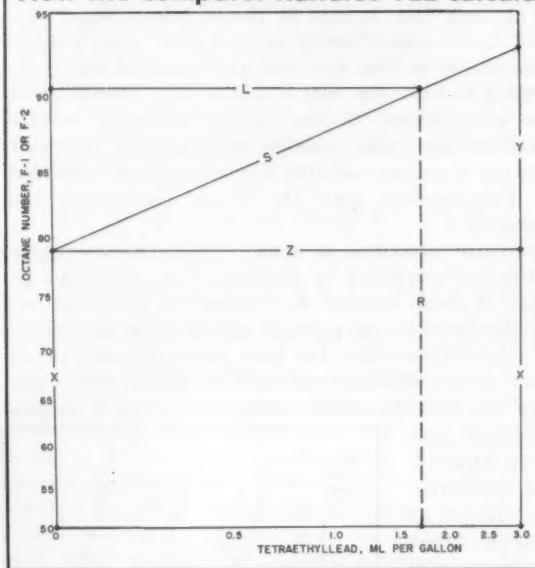
FIGURE 4—The Friedlander mechanism for stereospecific polymerization by a heterogeneous catalyst. (From Arthur V. Tobolsky.)

Cis-1,4-Polyisoprene is the nearest thing to natural rubber (Hevea rubber) made by man. It also represents one of the first of the ordered plastics. Natural rubber is *cis*-1,4-polyisoprene in which practically all of the isoprene units are arranged in an ordered fashion which permits the molecules to crystallize on extension.

The polyisoprene produced by use of a Ziegler type catalyst has been tested extensively and shown to be nearly identical to the natural polymer through infrared, X-ray and other physical methods. Military tires made from this rubber are reported to be superior to standard tires in respect to tread wear, tread life, tread cutting resistance and tread splice. Polyisoprene made by the use of lithium catalyst also has physical properties and polymer structure very similar to Hevea rubber. This rubber contains 93.8 percent *cis*-1,4- and 6 percent 3,4-structure compared to 97.8 percent and 2.2 percent respectively for Hevea rubber. It is very similar to Hevea rubber in its infrared absorption, X-ray diffraction, ozonolysis, unsaturation, carbon-hydrogen ratio, molecular weight distribution and inherent viscosity. It is entirely comparable to natural rubber in tires.

The place of the new stereospecific polyisoprenes in the tire picture is not easy to predict. There are many intangibles to consider including the price of natural rubber and the price and availability of the very high purity isoprene required. These and other factors have been ably evaluated by James D. D'Ianni in the recent PETROLEUM REFINER article "Look Again at Synthetic Rubber Industry" (**35 [12],** 164, December 1956). ##

How the computer handles TEL calculations



1. The TEL susceptibility chart is simulated in the computer using the following notations:

X = Unleaded octane units scaled.
$X + Y$ = Octanes at 3 cc TEL scaled.
Z = Horizontal scale of 0 to 3 cc TEL.
R = Octane units requirement scaled.
L = TEL requirement scaled.

Then,

$$L = \frac{Z(R-X)}{Y}$$

, and is transformed from the scaled units to the TEL requirement.

2. The units of each component unleaded and with 3 cc TEL are used as inputs.
3. The percent of each component is determined by the computer at the optimum level of operation of each process center.
4. In the final analysis, a triangle is constructed for the total pool gasoline similar to the manner used for the individual components.

The Optimum for Octanes

Champlin uses a digital computer to establish the best operations for their refining processes. Here is how it helps minimize the cost of making a given octane motor fuel.

Byron Horton and Earl Walker

Champlin Oil and Refining Company
Enid, Okla.

A NEW ELECTRONIC digital computer, commonly known by its trade name as ALWAC IIIe, was installed by the Champlin Oil and Refining Company to solve many complex and thorny refining problems. The computer was installed almost a year ago, following completion of a multi-million-dollar expansion and improvement program at the Enid, Okla., refinery. It helps Champlin refiners operate units at peak efficiency and minimum cost.

The initial problem chosen for programming established the optimum cost of octanes. The program was designed so that the computer would give quick and reliable answers based on predetermined gasoline pool requirements and a balanced refinery operation. Here are some of the factors which were considered:

Optimum reforming charge rate and octane level—This is handled in accordance with usual refinery accounting methods. An increase in catalytic reforming of low octane gasoline stocks represents the following debits:

Less finished gasoline
Increased variable costs and credits:
Decreased TEL costs
More fuel gas and LPG

Optimum cat cracker charge rate and conversion level—Here an increase in conversion of catalytic cracking represents the following debits:

Less burning oil
Increased variable costs and credits:
Decreased TEL costs
More fuel gas and LPG
More gasoline
More No. 1 fuel oil
Less No. 2 and No. 6 oil

Optimum TEL usage—Octane ratings are obtained on each component of the gasoline pool. These leaded and unleaded ratings are used to establish the TEL requirement of the pool in the manner shown in the accompanying box.

The program uses 1200 instructions for each operating level, and each problem consists of approximately 75 cases. Some of the blending information which comes out of this program is as follows:

1. Quantity of each component in pool including light blending materials for RVP requirement.
2. Octane numbers (F-1 and F-2) of each component at the lead dosage of the pool.
3. RVP.
4. ASTM distillation at 10 percent and 90 percent points.

In addition to solving octane blending problems, the computer is being used on mass spectrometer calculations. More recently a program was set up to reflect the blending operation when splitting pool gasoline into premium and regular grades. # #

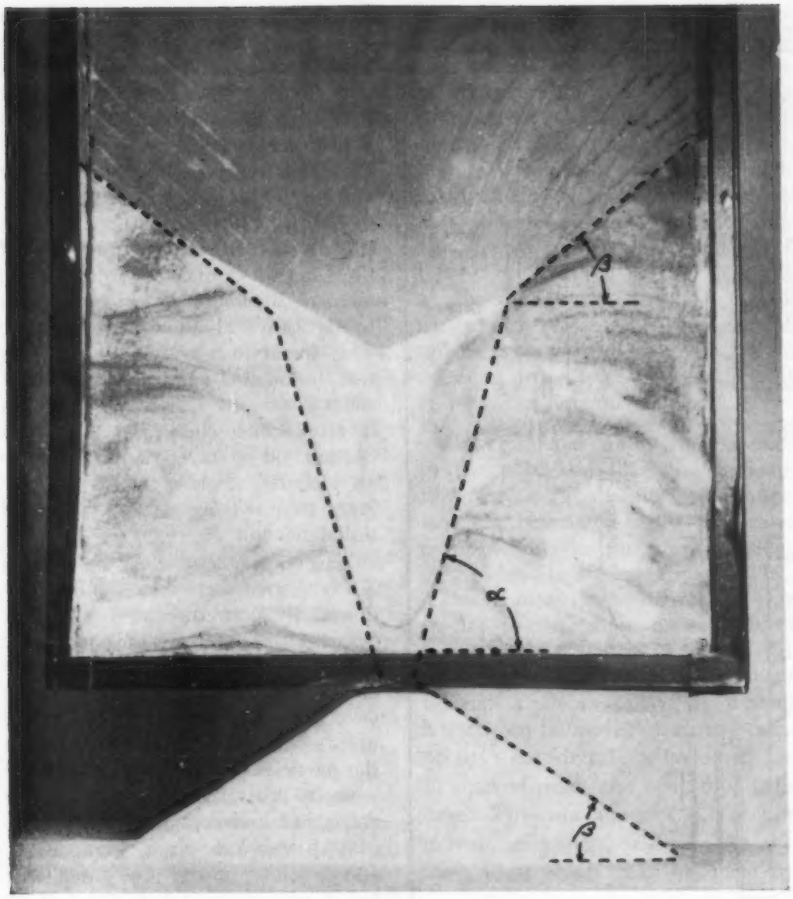


FIGURE 1—Bin flow of cracking catalyst showing α, angle of internal friction and β, angle of repose.

Fundamental studies in fluidization, along with process and mechanical improvements, have progressed in waves as research teams report results along various lines of attack. The present time appears to be ripe for an up-to-date orientation and appraisal of recent developments. Though even today very few phases of the subject are thoroughly defined, many of the loose ends can be tied together to comprise a fairly well-integrated picture both qualitatively and quantitatively.

This series of articles will cover the principal aspects of fluidization and orient this unit operation with the general subject of fluid-solid behavior in better understood and related fields. Though slanted toward the petroleum industry and particularly FCC and moving bed operations, the quantitative correlations are generally applicable to any fluid-solid system. The articles will serve three purposes:

1. Orient the various problems in design of fluid catalyst systems.
2. Provide the background data which have been accumulated over the years.
3. Present new correlations, new data and new theories to integrate related phenomena and suggestively stimulate further thinking in this field.

The material will be presented in a group of eight articles.

Fluid Catalyst Design Data—Part I

How Solid Catalysts Behave

Flow characteristics of bulk solids are now defined and organized into a logical pattern.

Frederick A. Zenz*
Roslyn Harbor, Long Island, N. Y.

THE DESIGN of bins, chutes, hoppers, moving bed heat exchangers, solids feeders, shaft type ore roasting furnaces, petroleum cracking units and numerous other process vessels through which granular solids move by gravity, presents problems that are frequently encountered in plant design. Space does not permit discussion of so broad a subject to any appreciable extent; however, there are certain fundamental angular properties of powders and granular solids which are important in understanding their behavior under such various process conditions. Many literature references discuss the characteristic angles assumed by powders under specified conditions, but as a whole this subject has never been approached broadly and a good deal of ambiguity exists as to the

* Presently with Walter Kidde Nuclear Laboratories, Garden City, N. Y.

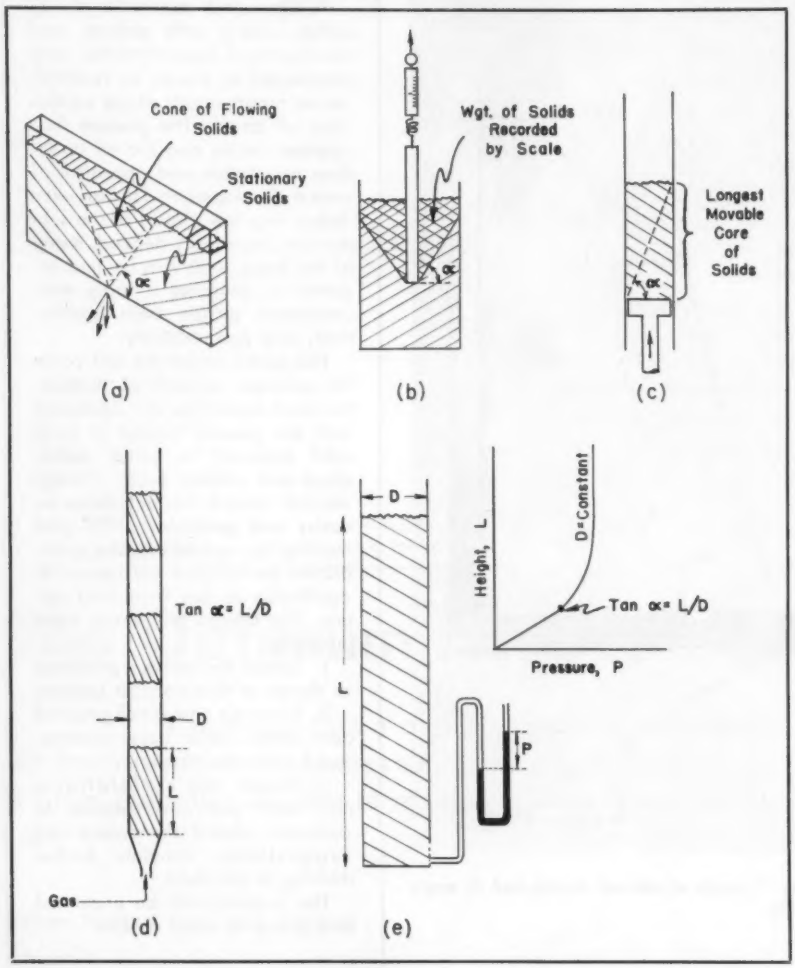


FIGURE 2—These are five methods of experimentally determining the angle of internal friction.

definition and methods of measurement. There are at least five commonly encountered angular properties of granular materials which will be discussed in order:

1. Angle of internal friction, α
2. Angle of repose, β
3. Angle of wall friction, γ
4. Angle of rupture, δ
5. Angle of slide, λ

The angle of internal friction, α is probably the most important fundamental property of a granular solid despite the fact that it is not one which is commonly observed. As the title implies, it is an internal phenomenon and therefore only detectable by suitable apparatus or test procedures. Figure 2 illustrates five apparent manifestations of the angle of ternal friction. All are adaptable to simple experimental measurement.

The first of these (Figure 2a) involves measuring internally the angle with the horizontal assumed by the moving core of solids in a vessel provided with a central opening through which the contents are flowing in free fall. This is the simplest method of measurement. The vessel should be rectangular with a plate glass or plastic front wall and as narrow, front-to-back, as is reasonable. The line of demarcation between stationary and flowing solids is usually quite marked, however, this can be accentuated by building up the original bed with alternate rows of differently colored particles.

The second method (Figure 2b) involves measuring the force required to pull a rod out of a bed of the solids. This manifestation of α was realized during a series of tests to determine the forces which could be anticipated during the cooling or heating of a metal surface such as a pipe, passing through a fixed bed of solids. To carry out this test the rod is held vertically in the center of the vessel while the solids are poured in and leveled at the surface.

Then a balance arm or spring scale is hooked to the top of the rod and the force in pounds recorded at the moment the rod is loosed and begins to move up and out of the bed freely. This instantaneous force in pounds was found to equal the weight of solids contained within and above an inverted cone whose apex is at the bottom end of the rod and which has an included angle equal to 180 degrees minus twice the angle of internal friction.

This experiment must be carried out with great care since the force required to loose the rod is very dependent on the state of packing of the bed. Should the vessel be tapped or shaken, during or after filling, a very high force will be recorded due to compaction or forced bridging of the particles. In fact the rod may not loose itself at all, and instead lift the entire bed and container.

With carefully (non compacted) added solids, it was also noted that for depths greater than 3 $\times$ (tube diameter $\times$ tan α) the submerged rod no longer pulled loose but lifted the entire bed plus containing vessel. This was noted even with smooth glass rods and with arrangements in which the weight of tube plus bed below the rod exceeded several fold the weight of the bed above the bottom end of the submerged rod. Presumably the application of greater external pulling force on the rod would in extreme instances result in either crushing of the bed catalyst, rupture of the containing tube, or failure of the rod in tension.

A third method of measuring the angle of internal friction is shown in (Figure 2c). This method consists of pouring the solids slowly into a tube fitted with a freely movable piston. It will be found that if the bed within the tube has a ratio of height to inside diameter of the tube less than a critical value it will be very easy to push the piston and bed up the tube. However, upon adding more solids and repeating the test at higher values of L/D, a critical height will be found above which it will be es-

sentially impossible to budge the piston in an upward direction. If carried out carefully this critical L/D is easily detected.

For example, using sand of about 480 micron (0.0189 inches) diameter in a ⅞-inch I.D. plastic tube a bed depth less than 1¾-inches could easily be pushed upward by hand; when a 2-inch bed height was tried, the 1/16-inch tube wall was ruptured by the applied force on the piston, without moving the bed upward. In a 2½-inch I.D. tube, a 4¾-inch bed of this sand could easily be moved upward by hand while with a 5-inch bed depth it was possible for a 180-pound man to place his entire weight on the tube, with the piston resting on the floor, and still not budge the plug of solids.

These experiments are very simple to perform but again care must be taken to pour the solids loosely into the tube in order to obtain reproducibility. Obviously the tube must be of fairly constant cross section, and the piston loose enough to move easily, but not permitting solids to lodge between it and the tube wall.

Table 1 summarizes the results of a series of observations with particles of rather widely differing physical characteristics, using principally the foregoing techniques. It must be emphasized that the experiments were exploratory in nature and should not be construed as being so precise as to make the fractions of a degree significant. It would, in fact, not be surprising to find that if repeated more methodically and carefully in more refined apparatus the absolute values of the measured angles would differ from those reported here by as much as one or two degrees. The significance of these data lies mainly in the apparent correlation of the single common property of a granular solid to its various manifestations.

Data gathered from various sources in the published literature indicate that the angle of internal friction may also be related to the L/D ratio corresponding to the onset of slugging in fluidization experiments. Thus a fourth means of measuring α, very similar to the piston experiment of Figure 2c, as shown in Figure 2d. This method involves introducing air through a porous grid at the base of a deep bed by means of a small compressor; the air rate is increased until slugs of solids rise up through the tube. The maximum L/D of the moving solid slugs, or the L/D above the grid at which slugs first form appears to correspond to the L/D obtained by the piston experiment.

Few investigators have made a thorough or even widely exploratory study of the bed heights corresponding to onset of slugging, but such data as are available appear to be in rather good agreement. Matheson et al[6] have reported such data carefully taken with four samples of synthetic cracking catalysts and an iron powder in ¾-inch, 1.2-inch, and 3-inch tubes. Cimler[3] also made careful visual fluidization and slugging studies with magnesium particles in a series of 5 tubes ranging from 0.42-inch to 4.0-inch in diameter. Leva et al[5] gave rough indications of the onset of slugging conditions in some of their experiments. The data of these investigators are summarized in Table 2 and Figure 3.

The data of Figure 3 are in remarkably good agreement considering the somewhat qualitative aspects of visual interpretation. This figure presents essentially all the factual information readily available to date in the literature on bubble growth and slugging. Figure 4 presents a comparison of some of the data of Figure 3 with curves computed from the equation presented by Yagi and Muchi[8] as correlating the bed heights

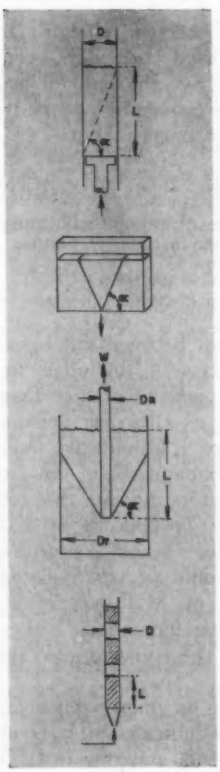


TABLE 1—Experimental Observations of α

Material:	Cracking Catalyst		Sand		TCC Bead Catalyst
Particle Diam.:	60 microns		480 microns		3000 microns
D:	⅞ inch	2½ inches	⅞ inch	2½ inches	2½ inches
L:	4½ inches	12½ inches	1⅞ inches	5 inch	8 inch
α:	79°	78.7°	65°	63½°	72½°

Material:	Cracking Catalyst	Sand	TCC Bead Catalyst
Particle Diam.:	60 microns	480 microns	3000 microns
α:	78.7°	63½°	71° (Data of Rausch[7])

Material:	Cracking Catalyst	Sand	TCC Bead Catalyst
Particle Diam.:	60 microns	480 microns	3000 microns
Bulk Density:	49.5 lbs./cu. ft.	92 lbs./cu. ft.	40 lbs./cu. ft.
D_R:	1 inch	⅝ inch	1 inch
D_T:	6.5 inches	2 inch	8 inch
L:	6 inch	3½ inches	14 inches
W:	0.63 pounds	0.28 pounds	7.7 pounds
α:	79°	64°	73°

Material:	Cracking Catalyst		Sand
Particle Diam.:	60 microns		480 microns
L/D:	4½/1	See Figure 3	2/1
α:	77½°		63½°

How Solid Catalysts Behave . . .

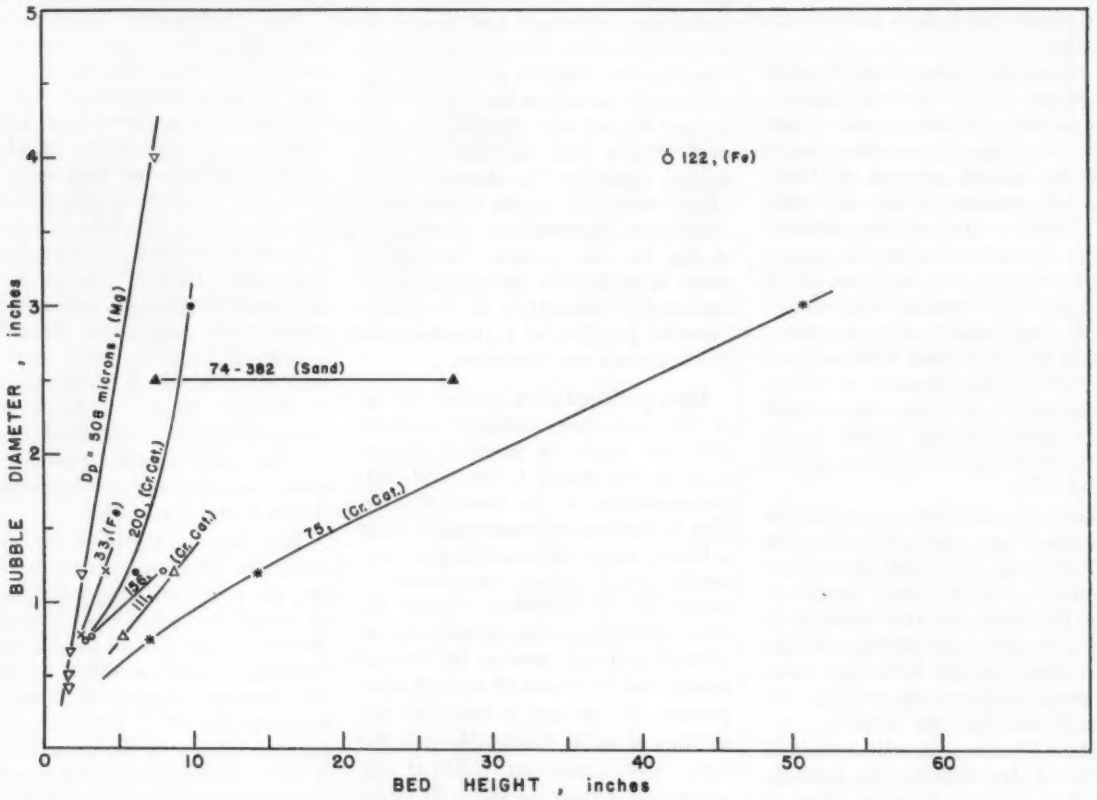


FIGURE 3—Here's how bubbles grow in fluidized beds. Bubble diameter versus Bed Height is shown for various materials based on data for initial slugging conditions in small tubes. See Table 2 for legend.

TABLE 2

Summary of Reported Data on Minimum Bed Heights Corresponding to Onset of Slugging in Gas-Solid Fluidization Studies

← Solids →				← Vessel →		
				← Gas →		
Material	Shape	Legend for Figure 3	Diam., microns	Bed Depth, ins.	Diam., ins.	Composition
Data of Matheson et al:						
Synthetic Cracking Catalyst	irregular	*	75	7.05	0.75	Air
				14.4	1.2	
				51.0	3.0	
		△	111	5.02	0.75	
				8.64	1.2	
		○	156	2.78	0.75	
				7.8	1.2	
	round	●	200	3.0	0.75	
				6.0	1.2	
				9.9	3.0	
		x	33	2.48	0.75	
Iron				4.08	1.2	
Data of Cimler:						
Magnesium Particles	irregular	▽	508	1.5	0.42	Air
				1.5	0.50	
				1.7	0.65	
				2.5	1.1875	
				7.5	4.0	
Data of Leva et al:						
Sand	round and irregular	▲	74-382	7.5-27.5	2.5	Air, He, CO_2
Fischer-Tropsch Catalyst	irregular	♦	122	42.0	4.0	Air

at which they observed slugging in beds of iron, sand, coke, and coal particles. They give the limit of bed height L_{SL}, where slugging occurs, by the relationship in c.g.s. units:

$$L_{SL} = 0.95\ D_t\ (D_P\ \rho)^{-0.3} \qquad (1)$$

where: D_t = pipe diameter (bubble diameter in terms of Figures 3 and 4)
D_P = particle diameter
ρ = particle density

The agreement between this equation and the data of the other investigators for particles greater than 100 microns is excellent as demonstrated in Figure 4. Qualitative indications of probable bubble sizes in commercial reactors indicate that for particles of say 75 microns in diameter the bubble sizes are much greater than would be extrapolated from the data of Matheson et al. These qualitative indications agree far better with the equation of Yagi and Muchi.

Note that for 60 micron particles Figure 4 would indicate an L/D of about 5 and for 480 microns an L/D

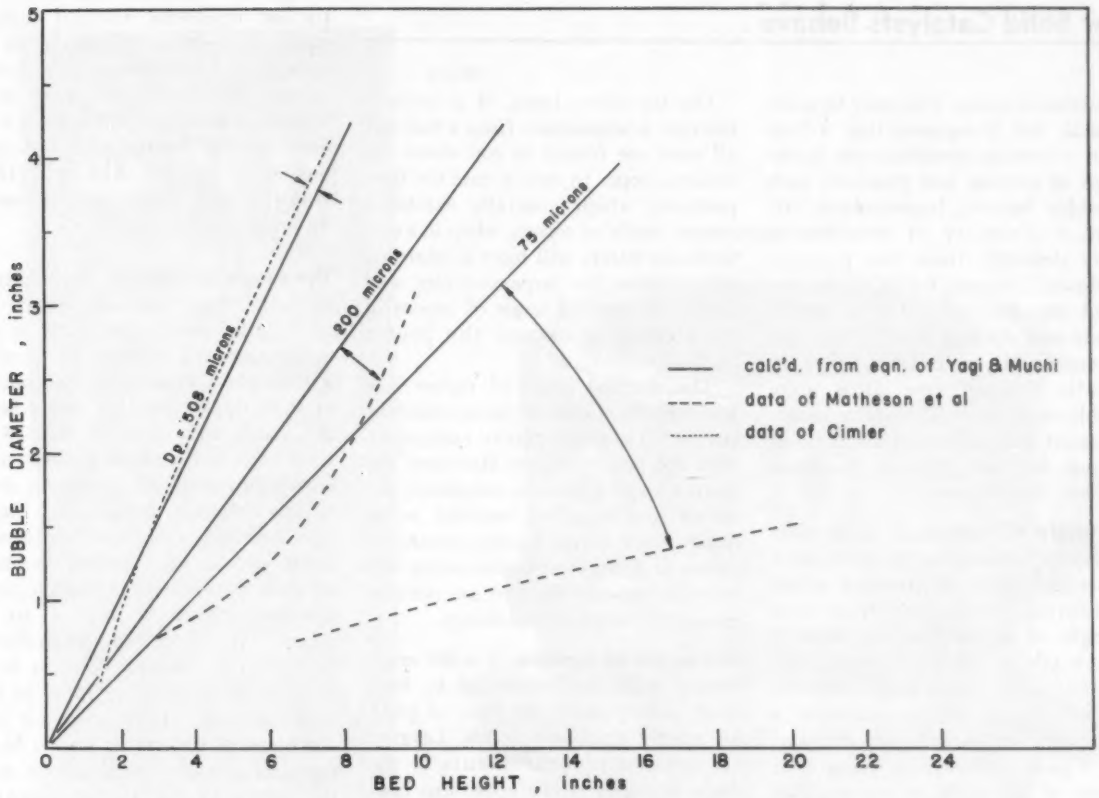


FIGURE 4—A comparison of the equation of Yagi and Muchi with the data of Cimler and Matheson, et al.

of approximately 2. This is in excellent agreement with the piston experiments reported in Table I assuming that both investigators' samples had essentially the same characteristic values of α. The discrepancy between the data of Matheson et al for 75 micron particles and the equation of Yagi may also not be real if a better parameter for Figures 3 and 4 were a rather than D_P.

A fifth manifestation of the angle of internal friction is illustrated in Figure 2e. Experiments have shown that the pressure at the base of a bed of solids increases proportionately with the bed depth up to a certain L/D at which the incremental pressure buildup begins to decrease and finally approaches a constant value independent of further increase in bed height. Ketchum,[4] in his text on "Design of Walls, Bins, and Grain Elevators" refers to the equations describing the lateral forces in bins which were derived by Wilfred Airy. Airy's derivations relate the angle of internal friction to the angle of repose and the coefficient of wall friction by the relation:

$$\tan \alpha = \mu + \sqrt{\mu \left(\frac{1+\mu^2}{\mu+\mu'}\right)} \qquad (2)$$

where α = angle of internal friction
μ = tangent of the angle of repose
μ' = tangent of the so-called angle of wall friction

He reports values of μ and μ' equal to 0.532 and 0.441 respectively. Substituting these values in the above equation, the angle α calculates to be 54 degrees. Results of an experiment with wheat using an apparatus such as described in Figure 2a yielded α equal to 55 degrees which is an excellent check. This crude test does not validate the application of angle of internal friction to the analysis of stresses in bins, but it does suggest that perhaps this is fundamentally the correct approach and should be further investigated. Ketchum suggests that μ' is a specific empirical quantity which must be experimentally determined by measuring stresses at the base of a model bin. From the wheat experiment it would appear that μ' could be obtained from the more easily measured angles α and β by rewriting Equation (2) as:

$$\mu' = \tan \beta \left[\frac{1+(\tan \beta)^2}{(\tan \alpha - \tan \beta)^2} - 1\right] \qquad (3)$$

The value of μ' from Equation (3) can then be used with either the Janssen[4] or Airy formulas for calculating bin stresses.

Exploratory tests have shown that the angle of internal friction may also manifest itself in determining flow profiles in downwardly moving beds. A 2½-inch diameter plastic tube fitted with a flat bottom containing a central opening was filled to a depth of 24 inches with 480 micron sand and observed during discharge. The upper surface of the bed remained horizontal, which suggested that the solids were moving downward at a uniform rate across the cross section of the tube. However, when the bed depth had decreased to 5 inches, a depression began to appear in the surface just above the hole through which the sand was discharging.

Note that the 5-inch level again corresponds to a bed L/D of 2:1 which in the previously described tests defined the tangent of the angle

of internal friction. This may be coincidental, but it suggests that α may be an important consideration in the design of moving bed processes such as pebble heaters, hypersorbers, etc. where uniformity of downflow is highly desirable from the process standpoint. Bearer[2], for example, discussed the flow of solids in pebble heaters and claimed that for the case he considered, an L/D of 1.7 gave perfectly uniform flow. It is quite possible that the solids which he investigated may have had an angle of internal friction whose tangent equalled 59.6 degrees.

The angle of repose, β, is the most commonly observed and measured angular property of granular solids. Actually there are two different types of angle of repose. One is obtained when a pile of solids is formed, and the other when it is drained. The difference between the two angles is a function of the particle size distribution. Figure 1 illustrates these two versions of the angle of repose. This photograph represents flow of a white powder from a rectangular experimental bin. It was found that stratifying the bed with another dark powder caused changes in the characteristic angles and therefore a new method was devised to permit photographic recording.

The transparent front face of the bin was given a slight static charge. A small amount of the black powder was put in the bin, swept over the charged face, and then emptied. This left a fine (though non-uniform) layer of the dark powder adhering to the front face. After the bin was filled with the white powder, the dark material was rubbed off at all points of flow when the bin discharged, thus serving the same purpose as stratification.

For a material of uniform particle size both measurements of β will be essentially the same; however, for wide size distributions the drained angle will be higher than the poured angle. This can be explained by the process of segregation which occurs when a uniform mixture of particles of various sizes discharges through an orifice onto a heap. In such a case the larger particles roll down the slopes, while the fines concentrate just below the point of discharge.

On the other hand, if a uniform mixture is withdrawn from a full bin, all sizes are forced to roll down the drained slope. In such a case the finer particles, which generally exhibit a steeper angle of repose, when in a uniform size batch, will have a retarding influence on the large particles, and cause the drained angle of repose of the mixture to exceed the poured angle.

The drained angle of repose is a truer representation of the equilibrium surface-to-atmosphere orientation than the poured angle. However, the poured angle is the one commonly observed and the one referred to in nearly every source quoting measured values of β. In most instances the differences between the two are not significant in engineering design.

The angle of rupture, δ, is the angle formed with the horizontal by bulk solids sliding under the force of gravity against stationary solids. Leygue[4] has reported measurements of the angle of rupture. His apparatus consisted of a box with a hinged or movable end holding back visibly stratified granular material between glass sides. Leygue observed that when the wall was tilted or moved the material behind it slid down the so-called plane of rupture breaking the visible strata and thereby permitting measurement of the angle δ.

The wedge of material contained between the movable side and the plane of rupture is the so-called "wedge of maximum thrust" referred to in civil engineering terminology in the design of retaining walls. It is commonly accepted that the angle of internal friction and the angle of rupture are one and the same. However, tests with various powders have shown that though in some instances the two are nearly equal, there are cases in which they are quite different. In general, the angle of internal friction is greatest, the angle of rupture less steep, and the angle of repose the shallowest. Fundamentally these angles differ in the nature of the interface they represent and therefore different values are to be anticipated.

For example, the angle of repose represents static equilibrium between uncontained solids and surrounding fluid medium. The angle of internal friction represents internal dynamic equilibrium between bulk solids and individual grains moving in contact against these bulk solids along an interface. The angle of rupture is defined by the interface formed when bulk solids (rather than individual grains) move under gravity against stationary bulk solids.

The angle of slide, λ, represents the frictional force between grains and an inclined solid surface. It is generally measured as the angle to which a steel plate supporting the material must be tipped from horizontal before the solids will slide off due to the force of gravity. This angular property is primarily of interest in determining whether hoppers or hopper cars handling relatively free flowing materials can be expected to empty all their contents when discharged, or whether additional shakers are required[1]. It also determines shallowest permissible hopper bottoms in instances where elevation must be kept to a minimum. In the academic sense the angle of slide must always be accompanied with qualifications as to the nature of the surface against which it was measured.

The experimental data gathered together here are presented mainly for their suggestive value in stimulating more extensive investigations and in correlating various apparently unrelated observations. It is doubtful, however, whether a means will ever be devised for predicting the flow characteristics of any powder under every set of prescribed conditions. Though these angular properties define the relative characteristics of one powder as compared to another, the absolute characteristics of a given material depend strongly on compaction, or in other words, time and method of handling. Only the flow characteristics of powders showing minor compressibility or compaction characteristics can be readily predicted.

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Part 2 will appear in an early issue of PETROLEUM REFINER.

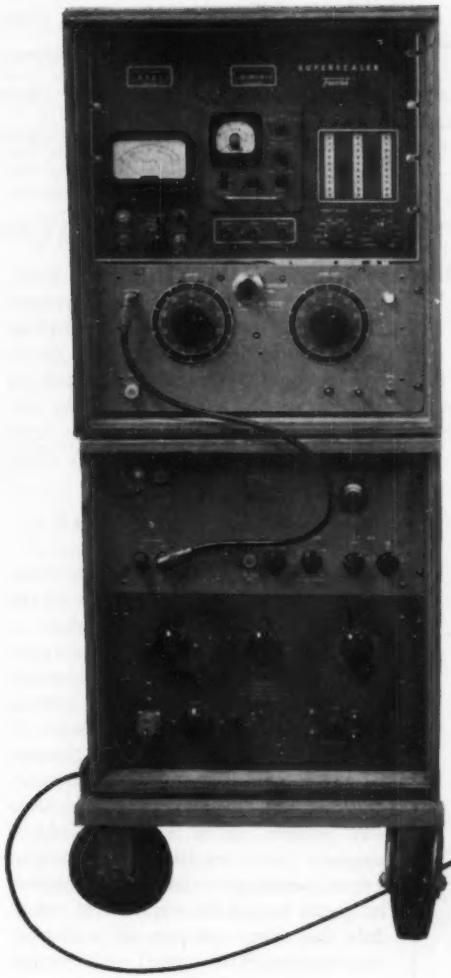
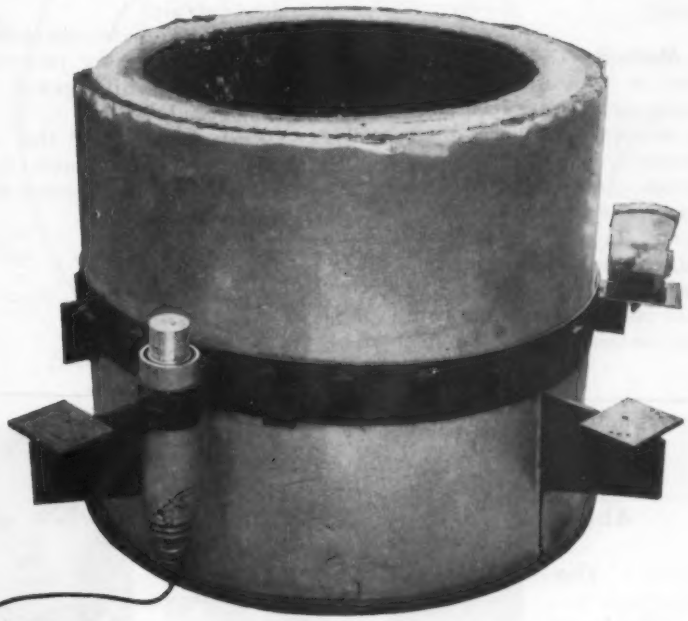


FIGURE 1

FIGURE 2



The gamma-ray spectrometer (Figure 1) was used in calibration and actual testing. Connected to the spectrometer by cable, the counter crystal tube is shown (Figure 2) mounted on the non-permanent positioning device that was used in calibration as well as actual testing on operating units.

Find Catalyst Density With Isotopes

Here is a new research technique using radioisotopes for quickly determining catalyst distribution in all phase regions of cat cracking units.

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Shell Oil Company
Houston

RECENT INNOVATIONS in catalytic cracking technology have made it extremely desirable to know both the average density and the density distribution of catalyst in risers as well as other areas of low catalyst density in the unit.

Gamma-ray absorption has been used in developing this new and accurate method of measuring this important variable. Heretofore measurement of fluid densities in operating cracking units has been confined to determination of average catalyst density in the well fluidized portions of dense beds by differential pressure measurements. However, this method cannot be used for determining densities in transport lines because part of the pressure drop results from energy consumed in particle acceleration and various frictional effects.

The gamma-ray technique developed for this new method is not limited by the size of the vessel or the line on which measurements may be made. It is only limited by practical considerations of the quantities of gamma-emitting material which can be handled safely. All equipment is

externally mounted and does not interfere with the process. It is applicable to any two-phase system in which the phases differ sufficiently in density or in mass absorption coefficient to permit accurate measurement.

Method—The quantitative absorption of gamma-rays by the catalyst along the path between a source and a detecting instrument must be determined before the mean catalyst density can be measured. A correction must be made for the absorption of gamma-rays by the vessel walls, insulation, and possibly internal equipment since all source and detecting instruments are external. To do this, two measurements of the intensity of radiation along each path were made.

- The "flow" measurement—made during the desired period of operation.
- The "zero" measurement—observed under identical conditions of geometry, etc., but the vessel contained only air.

This "zero" measurement also eliminated any need for correction because of the divergence of the gamma-ray beam.

It has been shown[1] that the following relationship holds for such measurements when mono-energetic gamma-rays are used.

$$\rho_m = \frac{\frac{1}{\alpha_p L_a} \ln \frac{I_z}{I_f} + \frac{\alpha_a \rho_a}{\alpha_p} - \frac{\alpha_g \rho_g}{\alpha_p}}{1 - \frac{\alpha_g \rho_g}{\alpha_p \rho_p}} \qquad (1)$$

where ρ_m = mean catalyst density along path
I_z = radiation intensity—zero measurement
I_f = radiation intensity—flow measurement
$\alpha_a, \alpha_g, \alpha_p$ = mass absorption coefficients of air, fluidizing gas, and catalyst, respectively
ρ_a, ρ_g = densities of air and fluidizing gas, respectively
L_a = path length within the vessel

Equation (1) is a general form, valid for all heterogenous systems. The terms for gamma-ray absorption of the fluidizing medium and of air are negligible compared to those for the catalyst. Consequently, the following simplified equation was used to calculate the average density along each path:

$$\rho_m = \frac{1}{\alpha_p L_a} \ln \frac{I_z}{I_f} \qquad (2)$$

To determine the density distribution existing in the cross-section of the vessel, ρ_m was determined along a number of intersecting paths. Intersections of the paths chosen formed a pattern which covered the area as completely as possible. Complexity of the pattern determines the number of paths required to obtain a satisfactory representation of the true density pattern. Even if the individual average path densities were without experimental error an infinite number of paths would be required to establish the true contours of a density distribution. The actual requirement to obtain patterns sufficiently well developed to correlate with other information about the system is much less stringent. It is also dependent on the method of resolving the experimental average path densities into the point density distribution since the method is implicitly one of the assumptions necessary to characterize the distribution.

Two methods have been used to calculate the catalyst density distribution from measurements of individual average path densities. In the first[1] the catalyst density at any point in the cross-section under study was assumed to be a polynomial function of the rectangular coordinates of that point. The coefficients of the polynomial were determined from the average path densities by a least squares curve fitting technique and the resulting equation was used to calculate the density pattern. The second method was a trial and error procedure. The point density at each intersection of paths in the cross sec-

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tion was adjusted graphically, or numerically with automatic computing equipment, until a density pattern was obtained which agreed with the measured average path densities.

Experimental—The equipment necessary for making gamma-ray density measurements consists of the following:

- A source of gamma radiation.
- A detector capable of quantitative measurement of the incident radiation.
- A means of reproducibly positioning the source and detector.
- A means of rejecting radiation arriving at the detector by a path other than the straight line from the source.

• **Sources**—The source of gamma radiation should be monoenergetic or, if several gamma-rays are emitted, the radiations should possess energies within a range narrow enough so that they may be treated as monoenergetic from the standpoint of mass absorption coefficient. The energy of the gamma rays should be great enough to provide sufficient penetration yet not so great that the mass absorption coefficient is too low to distinguish more or less subtle density differences. A range of energies from 0.5 to 1.5 Mev (million electron volts) has been found to be practical for this purpose. Two isotopes having energies falling in this range have been used extensively, namely, cobalt 60 (1.17 and 1.33 Mev) and cesium-barium 137 (0.66 Mev). Radiographic sources prepared from these isotopes are commercially available in small, hermetically sealed capsules of magnetic stainless steel.

• **Detector**—Any detector with a response quantitatively related to the radiation incident upon it may be used.

Both G-M (Geiger-Muller) and scintillation counters have been used to make density measurements. Scintillation counters are used almost exclusively at present because of their greater sensitivity and efficiency, even though more equipment is required for their use than G-M tubes.

The G-M counter system requires only a tube, preamplifier, scaler, and, as discussed later, possibly a collimating shield. However, the G-M tube has a definite life, changes its characteristics with age, is temperature sensitive to some extent, has a low volumetric counting efficiency, has a long dead time (compared to the scintillation counter) which limits its maximum counting rate, and cannot discriminate between gamma photons of different energies unless operated in the proportional counter region.

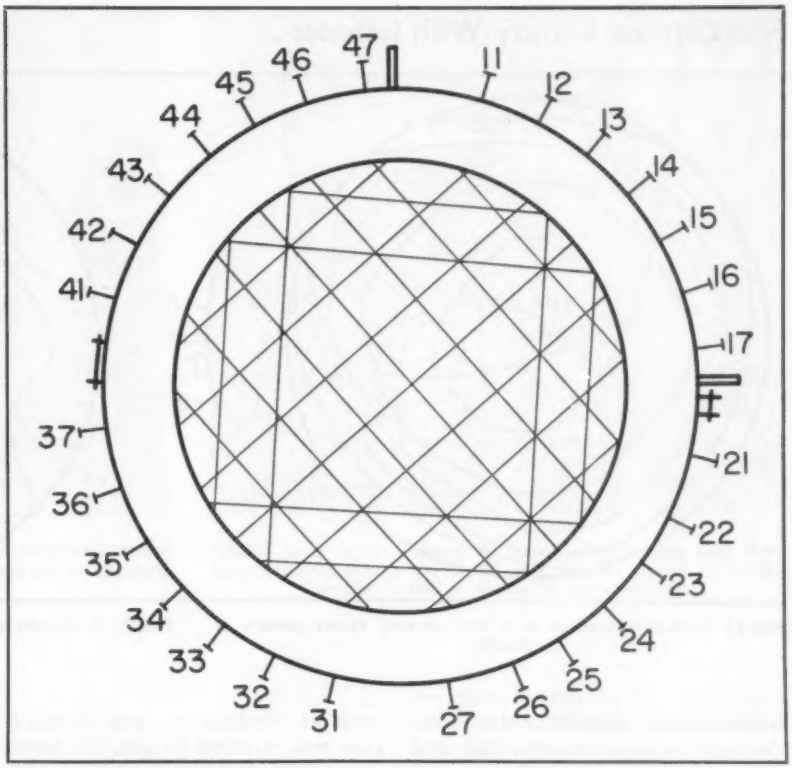

FIGURE 3—Diagram of path layout for gamma-ray measurement.

The scintillation counting devices presently in use require (1) a counter crystal and photomultiplier, (2) a linear preamplifier with cathode follower output (for remote operation), (3) a linear amplifier, (4) a pulse height analyzer, (5) a scaler, (6) a precision high voltage supply, and (7) a line voltage regulator. This equipment has been combined into the relatively compact and portable unit shown in Figure 1. In addition to greater efficiency, this system can count higher rates, without detector aging effects, and is capable of pulse height discrimination. Chief disadvantages of the system, which have been overcome with the accessory equipment, include the sensitivity of the photomultiplier tube (and the rest of the equipment to a lesser degree) to temperature, and sensitivity of the tube to changes in the output of the high voltage supply.

• **Positioning**—In order to insure that the source and detector are in the same position for the zero and flow measurements with equipment presently in use, small tapered dovetail brackets were welded either to a band clamped around the vessel, or to short lengths of pipe or steel strap which were welded directly to the unit. Matching clips are attached to the source holder and detector so that these can be quickly and accurately placed in position on the brackets (Figure 2).

• **Collimation**—The equations derived earlier are based on the assumption that the gamma-rays striking the detector traveled from the source in a straight line, that is, with no degradation of energy due to Compton scattering. However, an unshielded source emits in all directions and some radiation may reach the detector after being scattered from its surroundings one or more times. The absorption coefficient for this radiation may be considerably higher (depending on the energy loss) than that undergoing no scatter. If the scattered gamma radiation remains at all times within the path being studied the correct density may be obtained by experimentally determining the mass absorption coefficient for each path environment; if

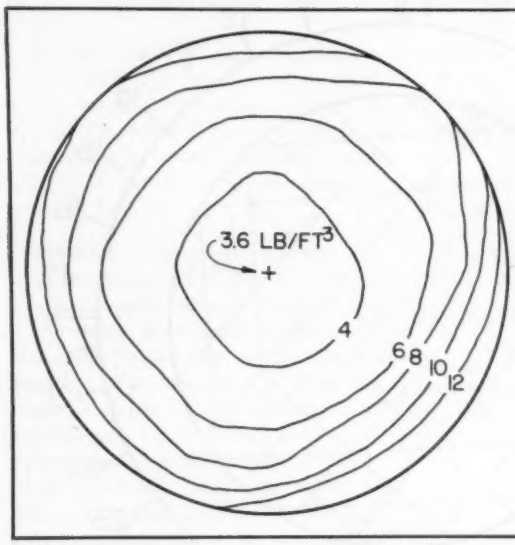

FIGURE 4—Density contours in a riser showing density pattern of catalyst.

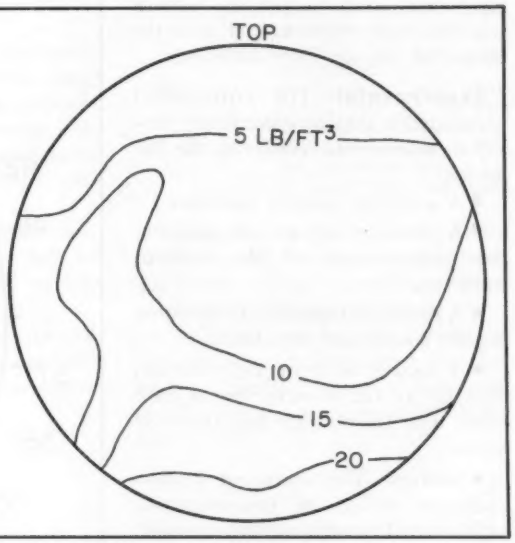

FIGURE 5—Density contours in a standpipe showing density pattern of catalyst.

it does not, the amount of this radiation must be measured separately and subtracted from the total zero and flow counting rates before the counting rate ratio is calculated. There is also a chance that the amount of scatter will change between readings, especially if the vessel is heated after the zero measurements are taken, so that the shape of the surroundings change. To eliminate these corrections some early measurements were made with lead shields over the source and receiver arranged to absorb any radiation which did not travel in the proper direction. These shields and their connecting structure were so cumbersome, and so much care was required to aim the beam properly, that attempts to closely collimate the beam were abandoned in favor of a less carefully collimated system. The results from this second procedure were satisfactory as long as gross changes in the surroundings did not occur and the absorption coefficient was measured experimentally and correlated with changes in path location.

The problem of collimation was really not solved satisfactorily until the gamma-ray spectrometer was developed. This instrument, employing a scintillation counter with pulse height discrimination, allows rejection of the scattered radiation so that no collimation is required.

Applications—A typical application of gamma-ray density measurements was the determination of the density distribution over a cross-section of a vertical catalyst riser in a commercial catalytic cracking unit. Table 1 shows experimental zero and flow counting rates obtained by means of a scintillation counter with a gamma-ray spectrometer. The geometrical pattern of the paths measured through this cross-section is shown in Figure 3. The density contours shown in Figure 4 were obtained from the mean path densities obtained from the data of Table 1 by the successive approximation method of calculation.

Another application shown in Figure 5 presents the density contours in a cross-section of an inclined catalyst standpipe. The low density region near the top of the cross-section was due to loss of fluidization as the catalyst flowed through the standpipe. These are two examples of the information obtainable from density patterns which may be useful in the operation or design of commercial units.

TABLE 1

TYPICAL DATA FROM GAMMA-RAY MEASUREMENTS

PATH S	PATH D	LENGTH, FT	ZERO INTENSITY, CTS/MIN	FLOW INTENSITY, CTS/MIN	DENSITY, LBS/FT^3
11	37	2.22	158127	74827	9.1
12	36	3.02	257610	115780	7.2
12	26	1.98	275334	136124	9.6
13	25	1.97	125925	47722	13.3
13	35	3.41	375619	192266	5.3
.	.	.	.	.	.
.	.	.	.	.	.

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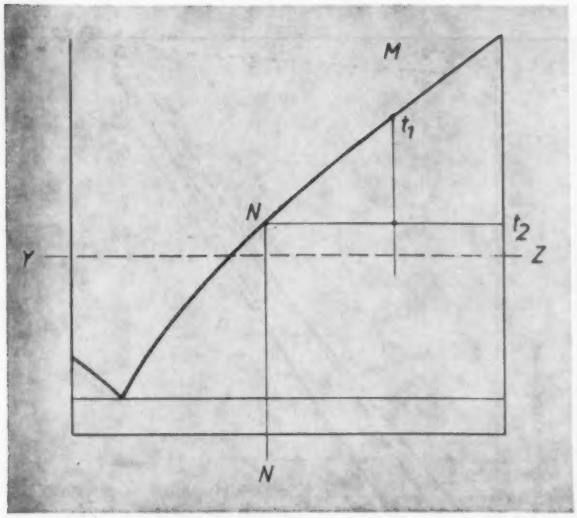

FIGURE 4—The solidification diagram is a plot of temperature versus composition. It is used to show the boundary betewen the homogeneous and heterogeneous phases.

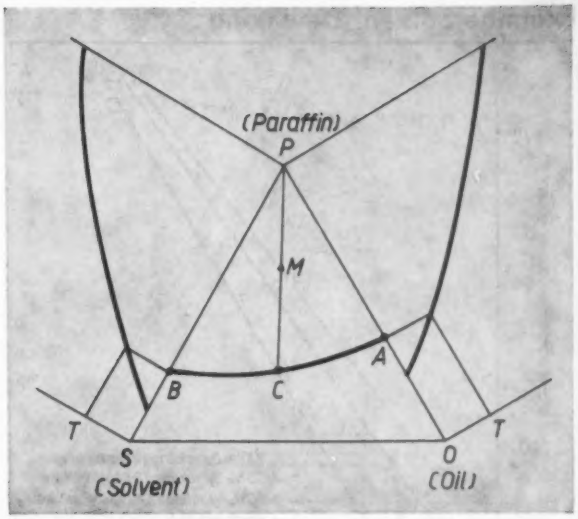

FIGURE 5—A ternary diagram is made by transferring data from temperature-composition curves. In this and the figures to follow, "paraffin" is used to denote the wax component.

Part 2

Examine Solvent Dewaxing

A method is described for handling dewaxing problems on triangular graph paper.

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CALCULATION OF DEWAXING is most favorably carried out in a ternary (triangular) diagram. Directives on this subject have already been given in some cases[1, 2, 8, 10]; however, up to now only in a very general manner. After having dealt with various experimental results in Part I, which may serve as general basis for dewaxing, the following should demonstrate a simple calculation of laboratory results and a number of basic application possibilities.

As shown in Part I, it is necessary to carry out dewaxing in the one-phase region, in order to achieve satisfactory results. In the region of one liquid phase, the mixture consists of three components, namely: solvent, oil and wax. This ternary mixture may be thought composed of three binary mixtures, whereby the mixture oil-wax—in spite of the complex character of this substance—may be considered as binary with the simplifications still admitted.[1, 2]

Figure 4 is the solidification diagram of a binary mixture in which the temperature is shown on the abscissa and the composition in weight or volume percentage is shown on the ordinate,

This is the last part of the informative study on solvent dewaxing. The first part presented data to show the effectiveness of various solvent mixtures. This second and last part describes an easy method for handling solvent dewaxing data.

the curve represents the equilibrium line between the homogeneous and the heterogeneous phases.

If a paraffinic mineral oil with a composition M (see Figure 4) is cooled down, the separation of wax begins at temperature t_1 and, consequently, the cloud point is reached. If cooling is continued, wax continues to separate from the oil and the composition of the liquid phase changes along the solid-liquid equilibrium line. If the mixture of the composition M is immediately cooled down to temperature t_2, the mixture disproportionates to wax and a liquid with a composition N corresponding to the intersection point of the temperature line with the equilibrium curve.

Graphic Demonstration. A graphical representation may be made for each of the three binary mixtures. By bringing the respective angle points of the three binary diagrams into connection, a ternary diagram is formed, which permits the statement of conditions and changes in ternary systems. Since all oil-solvent mixtures in practical dewaxing operations are liquid in the applied temperature area, it is possible to eliminate entirely the solid-liquid equilibrium line of the oil-solvent side of the ternary diagram. Furthermore, on the diagram side wax-oil and wax-solvent only those solid-liquid lines are needed which fall

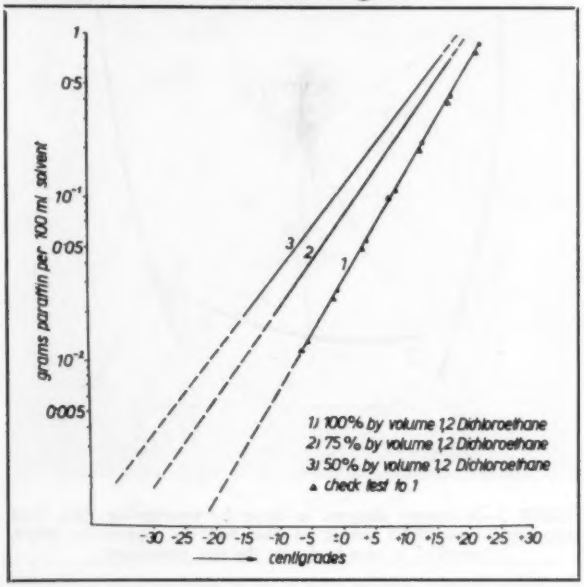

FIGURE 6—The solubility of an Austrian long-residuum wax in mixtures of 1,2- and 1, 1-dichloroethane is shown here. These data were obtained in preparation for a tenary diagram.

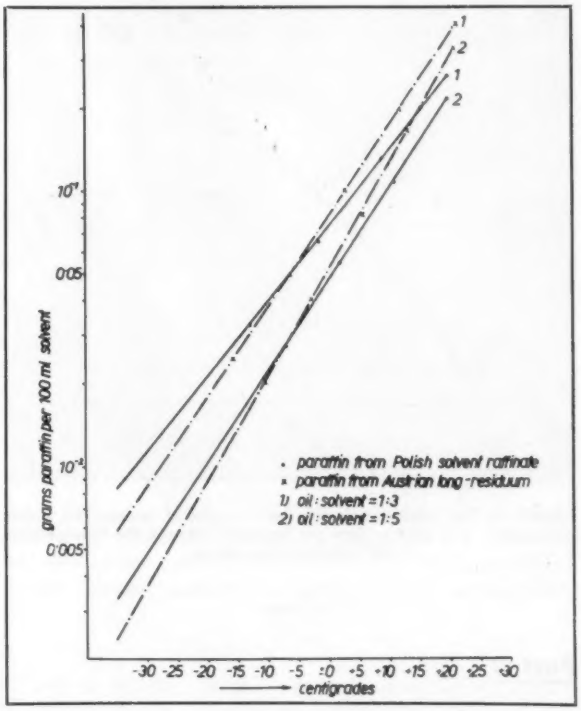

FIGURE 7—Here is the solubility of an oil's own wax for two oil-solvent ratios.

into temperature areas above the freezing point of pure oil or pure solvents, respectively. Naturally only lines above the eutectic points of wax-oil and wax-solvent mixtures also are needed if these can be considered to exist at all. For these two sides of the ternary diagram the diagram in Figure 4 may be simplified according to the dashed line YZ. Finally a ternary diagram is obtained as shown in Figure 5.

For the temperature T the point A on the diagram side PO corresponds with the composition of the liquid phase (a solution of wax in oil) in equilibrium with solid wax. At the same time point B on side PS shows the composition of the liquid phase (a solution of wax in solvent) kept in equilibrium with solid wax at the same temperature. Point C illustrates, therefore, the composition of all three components in equilibrium with solid wax. The lines PA, PB and PC are equilibrium lines or tie lines (conodes). Every mixture shown as a point within the area ABP, must exist in two phases: one solid phase (wax) in equilibrium with a liquid phase which is illustrated by a point on the line ACB. For instance, the mixture shown by point M disproportionates at the temperature T into wax and into a liquid phase with the composition C. The disproportionation occurs along the tie line PMC.

Following the proportionality rules in a ternary diagram, whereby the quantities of phases are related as the lengths of line sections, the solid part will be in relation to the liquid part as the distance CM to the distance MP. All compositions determined, which are demonstrated by points within the area SOAB, consist at temperature T only out of one phase—the liquid. The curve ACB, therefore, separates the one-phase region from the two-phase region and is thus the solubility curve.

Determining the Solubility Curve. The solubility curve must be determined in order to apply the ternary diagram to graphic calculations of dewaxing problems. Cooling down a liquid mixture of oil, solvent and wax effects a cloudy solution when attaining the equilibrium point with solid wax. The determination of the cloud point of a solution of oil, solvent and wax is a convenient method for placing a point on the solubility curve of the ternary diagram.

Through the determination of the cloud points of several mixtures of wax, oil and solvent, the relation between wax content and cloud point is obtained. See Figures 6 and 7 which represent plots of the data reported in Tables iv and Table v, respectively.

As intersection point between the determined straight line and the chosen dewaxing temperature, the wax content still in solution is attained. Thus points are obtained for the solubility curve in the ternary diagram.

From Figures 6 and 7 it may further be seen that the solubility of wax in oil-solvent mixtures is rather low at the applied low temperatures. This corresponds with previous results.[14]

Therefore, it may be stated that for the usual dewaxing temperatures the solubility line practically falls together with the base line of the ternary diagram if a not too large scale of the diagram is used.

Fix-Points. A determination of the fix-points is the next step. Referring to Figure 8, if a mixture of the composition M consisting of oil, solvent and wax is cooled down, it splits up along a tie line into wax and a liquid corresponding with a composition F_2. During filtration, however, liquid phase of the composition F_2 is mechanically retained at the solid phase, so that a filter cake P_2 is obtained which contains wax, oil and solvent. After the distillation of the solvent, the oil remains in the wax and the percentage of this oil can immediately be determined by means of the ternary diagram.

Since the line sections $F_2M : MP_2$

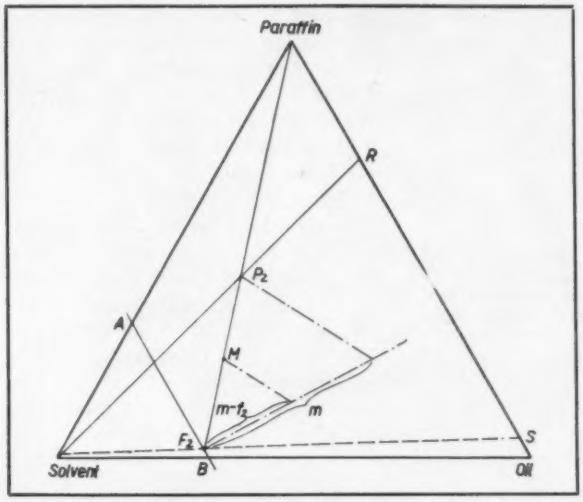

FIGURE 8—The ternary diagram may be used for calculating dewaxing at higher temperatures at which the solubility of wax can no longer be neglected.

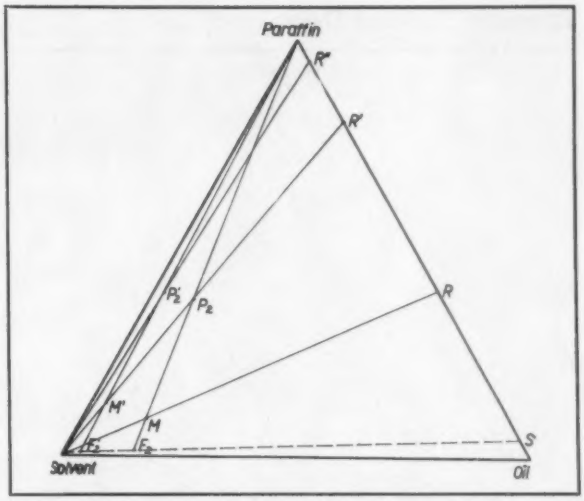

FIGURE 9—The quantity of solvent needed may be evaluated graphically.

correspond with the quantities $P_2 : F_2$, the quantity of the filter cake can be determined directly from the quantity balance between filtrate and starting material. This point P_2 can be graphically located with the assistance of an auxiliary radius. Thereby m determines the weight of the starting material and f_2 the weight of the filtrate.—$m—f_2$ is therefore the weight of the filter cake.

If solvent is distilled from the filter cake, one moves along the line which leads from the apex point S, representing the solvent, in the ternary diagram through point P_2 to side OP. There the percentage of oil content in the filter cake may be found. (point R).

The line AB is a line of constant solvent content and can be used to control F_2. If solvent is distilled out of the liquid phase F_2 and the percentage of the solvent in that phase is marked on side SO, a parallel to side PO through point B has to go also through point F_2 if the solubility line has been determined accurately. If, however, the solubility curve is not the same as the base line, as shown in our case, this curve is a straight line[1] and is represented in Figure 8 by the line which leads from the solvent apex to point S'. Therefore, the ternary can be used for calculating dewaxings at higher temperatures at which the solubility of wax can no longer be neglected.

If the composition of the wax-oil mixture is known, for instance, from a preceding analysis, the stages which are necessary for a certain de-oiling of the slack wax, respectively the favorable quantity of solvent may be evaluated graphically as shown in Figure 9.

On the wax-oil side of the diagram the composition of the mixture is marked. Then this point (R) is connected with apex S. All mixtures with the same wax-oil proportion, independent from the quantity of the solvent in the mixture, are represented by points

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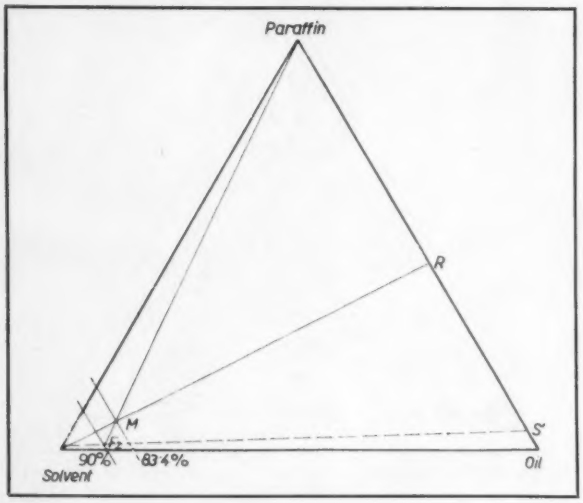

FIGURE 10—The unknown content of wax for an oil may be determined from a ternary diagram.

on that straight line. If one takes, for instance, an oil-solvent proportion of 1:5, this straight line is divided into six parts. At the graduation mark 1—counted from apex S—the point M is situated, which represents the composition of the mixture of oil to be dewaxed with the solvent.

As already described, this mixture M disproportionates into liquid phase F_2 and the solid phase P. At the filtration, the filter cake with the composition P_2 is obtained, of which the oil content may be graphically determined after the distillation of the solvent. (point R′).

The second stage is similarly graphically determined, whereby the addition of solvent leads to point M′, resulting after filtration in point F_2' and P_2'.

From Figure 9 it may clearly be seen how many stages will be sufficient for dewaxing a certain charging material. Furthermore, the quantity of solvent may be varied for pre-determining the most favorable effects for practical purposes. It must be mentioned that the proportion of filter cake to filtrate varies according to the equipment (band filters, filter presses or centrifuges).

The determination of compositions of the filter cake and of filtrate through the quantity balance, is precise enough for practical purposes and spares the tedious analyzing of yielded products.

It may be understood from Figure 9 that each point M must lie on a straight line which leads from the wax-oil side of the ternary diagram to the solvent Apex. This fact may now be used for computations if there is an oil to be dewaxed of which the wax content is unknown.

From the weighed portion of waxy oil and solvent of, for instance, 1:5 we know that the solvent part amounts to 83.34 percent weight of the total mixture. This point is marked on the solvent-oil side of the diagram in Figure 10, and a parallel AB to the oil-wax side is drawn through this point which represents the line of constant solvent content over all possible mixtures. Now filtration is done and the quantity of solvent is determined in the filtrate. This quantity may be for instance 90 percent. This point is then marked on the oil-solvent side. A parallel to AB—which leads through this point (CD)—denotes the composition F_2 as the intersection point with the solubility line. Through this point F_2 now a tie line is drawn to the wax apex. The intersection point of this tie line with the straight line AB denotes the point M.

In the same manner as described previously, a straight line is drawn through this point and the solvent Apex, which results as an intersection point with the wax-oil side of the diagram in point R. This point represents the original composition of the oil to be dewaxed. Now it can be proceeded in the same way as described in Figure 9.

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APPENDIX

TABLE iv
Solubility of Austrian Wax[1]

100% 1,2-DICHLOROETHANE

TEST 1		TEST 2 [2]	
Wax, gm/100 ml Solution	Cloud Point °C	Wax, gm/100 ml Solution	Cloud Point, °C
0.8848	21.5	0.8016	21.0
0.4424	17.0	0.4008	16.5
0.2212	12.5	0.2004	12.0
0.1106	8.0	0.1002	7.0
0.0553	3.5	0.0501	3.0
0.0276	—1.0	0.0250	—1.5
0.0138	—5.5	0.0125	—6.5

75% 1,2-Dichloroethane 25% 1,1-Dichloroethane		50% 1,2-Dichloroethane 50% 1,1-Dichloroethane	
Wax, gm/100 ml Solution	Cloud Point, °C	Wax, gm/100 ml Solution	Cloud Point, °C
1.2432	21.5	1.5022	21.5
0.6216	16.5	0.7511	15.5
0.3108	11.0	0.3755	9.5
0.1554	6.0	0.1877	3.5
0.0777	0.5	0.0938	—2.5
0.0388	—5.0	0.0469	—8.0
0.0194	—10.0	0.0235	—14.0

[1] Austrian microcrystalline long-residuum wax, melting point 64 C.
[2] Test 2 is a duplicate of Test 1 in order to show the precise results obtained by this method.

TABLE v

Solubility of the oil's own wax in mixtures of dewaxed Polish Solvent Raffinate with 55% Vol. of 1,2-dischloroethane and 45% Vol. 1,1-dichloroethane in various oil-solvent ratios.

OIL : SOLVENT = 1 : 5		OIL : SOLVENT = 1 : 3	
Wax, gm/100 ml Solution	Cloud Point, °C	Wax, gm/100 ml Solution	Cloud Point, °C
2.1638	20.0	2.5932	20.0
1.0819	11.0	1.2966	9.0
0.5409	2.0	0.6488	—0.5
0.2704	—7.0	0.3244	—13.0

Solubility of the oil's own wax in mixtures of dewaxed Austrian long-residuum with 70% Vol. 1,2-dichloroethane and 30% Vol. 1,1-dichloroethane in various oil-solvent ratios.

OIL : SOLVENT = 1 : 5		OIL : SOLVENT = 1 : 3	
Wax, gm/100 ml Solution	Cloud Point, °C	Wax, gm/100 ml Solution	Cloud Point, °C
3.2641	21.0	3.9543	21.5
1.6320	13.5	1.9771	12.0
0.8160	6.0	0.9885	3.0
0.4080	—2.5	0.4942	—6.0
0.2040	—10.5	0.2471	—15.5

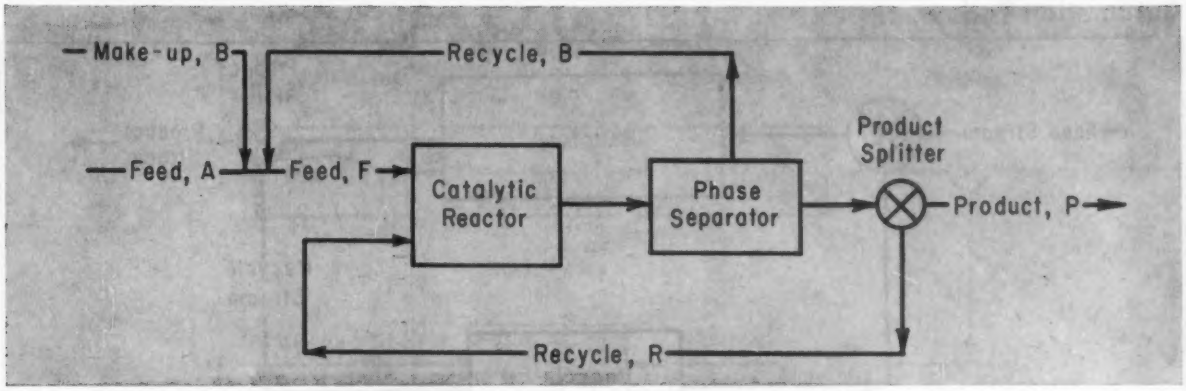

FIGURE 57—In this chemical reaction, it is assumed that reactant *B* is immiscible with a mixture of reactant *A* and product *C*. It is assumed also that some of the product is recycled to reduce the over-all reaction rate.

Automation Today, Part 10

When the process element of a control loop is a chemical reaction, here is the treatment which may be used to establish automatic control.

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IT IS WELL to consider each element of a control loop when setting up an automatic control system. In this series we considered the sampling element (Part 7), the control element (Part 8), and the process itself (Part 9). In Part 9 the process was a heat exchanger. Now we will consider that the process is a chemical reaction.

The system here will be very much simplified. A more exact derivation or the consideration of a more complex system would be carried out in much the same manner except that the resulting equation will become much more complex as fewer simplifying assumptions are made.

A CATALYTIC REACTOR—SIMPLIFIED CASE

As a chemical process to be used as an example to illustrate the method of treatment, let us choose a chemical reactor system such as is shown in Figure 57. The reaction undergone in the process will be a catalytically induced combination such as is detailed by the general chemical equation:

$$A + B \rightarrow C \qquad (1)$$

Furthermore, let us assume that component *B* is immiscible with the mixture of component *A* and product *C*. Also, let component *B* be in very great excess in the reactor. Therefore, the reaction can be considered first order in component *A* and the rate of reaction in the presence of the proper catalyst can be given by the equation[2]:

$$\frac{dC}{dt} = V\, x_A\, f(T) = \frac{-dA}{dt} \qquad (2)$$

Here dC/dt is the date of production of component *C* and — dA/dt is the corresponding rate by which component *A* is used up in cubic feet per second. In addition, *V* is the active volume of the reactor under consideration; x_A is the volume fraction of component *A;* and *f(T)* is the reaction constant given here as an, as yet, unspecified function of temperature. The importance of the *f(T)* function will be brought out later.

If the over-all rate of reaction is excessive, a major recycle of both components is necessary for a proper controlled operation of the process. It is this recycle which can cause oscillations in the process when under certain conditions of operation and with certain types of reaction kinetics as we will also show.

If now we can assume a constant throughput of reactant liquids through the reactor, and if in addition we can assume that the makeup of component *B* is independently regulated, we need consider only the flow and fractional composition of component *A* in the problem. Therefore, a preliminary block diagram of the process will appear as in Figure 58.

The composition of the input stream is a function of the over-all feed rate, *F*, and $\overline{A}$, the rate of input of component *A*, as follows:

$$x_{A_f} = \frac{\overline{A}}{F}, \text{ or } F x_{A_f} = \overline{A} \qquad (3)$$

As Figure 57 shows, *F* is composed of the component *B* recycle stream, the component *B* makeup stream, and the component *A* input. We are considering only the component *A* input as variable.

Fluid Dynamics. Let us now look at the fluid dynamics involved in the process. The catalyst bed with its multi-

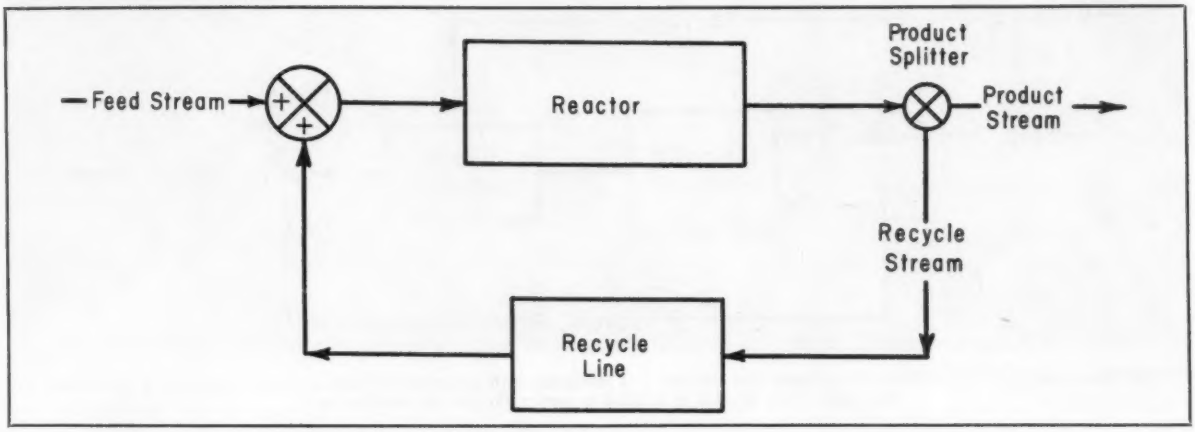

FIGURE 58—Here is a block diagram of the chemical reaction process showing the control loop.

tude of small channels and pores should cause a very thorough mixing of the two phase system. However, these same channels and pores also set up a considerable resistance to the flow of fluid through them. This results in a finite true time delay for the liquid flowing through the reactor and thus a definite average *residence time*, τ_r, of the reactants in contact with the catalyst.

If the function $f(T)$ is in its simplest form, that is, it is a constant and the reaction is independent of temperature, then the reactor may be considered as a single unit in our development. Thus, we can specify the output composition as a function of the input composition through a single set of equations. In deriving these equations let us first allow, for purposes of convenience, that the entering material is affected by the true time lag and mixing delay prior to any reaction.

As we have previously shown the effects of such a combination of a true time lag and a mixing delay can be represented by the expression,

$$\frac{x_2}{x_1} = \frac{e^{-p\tau_r}}{\tau_m p + 1} \tag{4}$$

where τ_r is the equivalent true time lag and τ_m is the mixing delay time constant. On the block diagram we can thus split the block representing the reactor into three parts: one, representing the effect of the time lag; the second, to represent the mixing delay; and finally the third, to represent the reaction which is taking place. See Figure 59 for a block diagram of these delays. Therefore, the liquid composition prior to any reaction is the following function of the two input streams:

$$x_{A\,in} = \left[\frac{F x_{A_f} + R\,x_{A_R}}{V}\right] \frac{e^{-p\tau_r}}{\tau_m p + 1} \tag{5}$$

With the two constituents as liquids, the output rate will equal the input rate. The constant throughput rate in equation form would be

$$O = F + R = Q. \tag{6}$$

Therefore, the change in the average composition of component *A* in the reactor without considering any effect of reaction as yet would be given by

$$\frac{dx_A}{dt} = \frac{(F+R)\,x_{A\,in} - (O)\,x_{A\,out}}{V}$$

$$= \frac{Q}{V}(x_{A\,in} - x_{A\,out}) \tag{7}$$

which is a standard material balance equation.

Since we are considering perfect mixing to take place in the reactor x_A and $x_{A\,out}$ will be identical. Thus Equation 7 will read

$$\frac{dx_A}{dt} = \frac{Q}{V}(x_{A\,in} - x_A) \tag{7a}$$

and

$$x_{A\,no\ reaction} = x_{A\,initial} + \int_0^t \left[\frac{Q}{V}(x_{A\,in} - x_A)\right] dt \tag{8}$$

Consider the reaction now takes place so that the output composition, x_A, can be represented by the formula

$$\frac{dx_A}{dt} = \frac{Q}{V}(x_{A\,in} - x_A) - \frac{dx_C}{dt} \tag{9}$$

and

$$x_A = x_{A\,initial} + \int_0^t \left[\frac{Q}{V}(x_{A\,in} - x_A)\right] dt - x_C \tag{10}$$

The volume fraction of product C which is formed, x_C, is found by integrating the reaction equation, Equation 2.

$$x_C = \frac{\int dC}{V}$$

$$= \int_0^{\tau_r} x_A f(T)\, dt$$

$$= x_A f(T)\, \tau_r$$

$$= (x_A)(K)(\tau_r) \tag{11}$$

This is true since $f(T)$ is a constant, K, and the residence time, or time in which reaction can occur, is τ_r as previously specified.

The reader will notice that we have made two uses of the factor, τ_r in what might be considered contradictory senses from the physical standpoint. That is, we used τ_r to define a true time lag period for fluid flow prior to reaction and then used it again to define the reaction period or residence time. In the actual case both of these will occur simultaneously, of course, but the mathematical

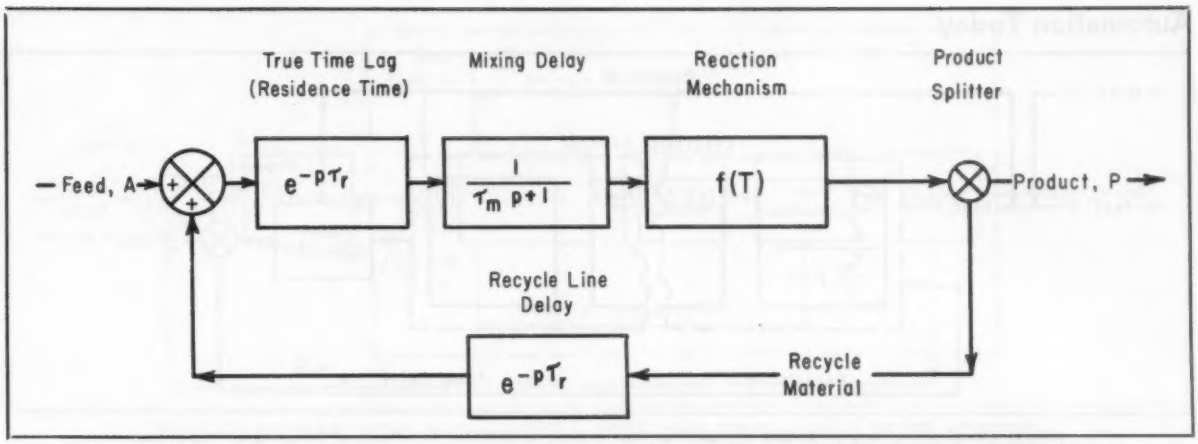

FIGURE 59—The block representing the reactor may be divided into three parts: time lag, mixing delay and reaction rate.

representation of such an exact phenomenon would require the use of partial differential equations which we wish to avoid in this series. Thus we must make the simplifying assumptions of separating the fluid flow and reaction mechanisms.

Upon leaving the reactor, the mixture of reactant *A* and product *C* is separated from reactant *B* by the phase separator. The resulting product stream has a volume equal to

$$R' = (x_A + x_C)\,Q \tag{12}$$

and a composition equal to

$$x_R' = \frac{x_A}{x_A + x_C} \tag{13}$$

When a certain portion, *P*, is removed as product, we have the amount of recycle, i.e.

$$R'' = R' - P \tag{14}$$

If the reflux line is considered to be running full, changes in rate at the product takeoff point are transmitted instantaneously to the reflux inlet point and

$$R = R'' \tag{15}$$

Therefore,

$$R = (x_A + x_C)\,Q - P \tag{16}$$

However, because of the amount of time which is required to traverse the recycle line, τ_R the composition of the recycle material as it enters the reactor must be expressed as

$$x_{A_R} = x_{A_R'} e^{-p\tau_R} = \frac{x_A}{x_A + x_C}\, e^{-p\tau_R} \tag{17}$$

and

$$Rx_{A_R} = [(x_A + x_C)\,Q - P]\,(x_{A_R'} e^{-p\tau_R} \tag{18}$$

To get a solution to the problem, the next step would be to collect the equations annotated above and express x_A in as compact a manner as possible. We could begin by combining Equations 10 and 11 to give

$$x_A = x_{A\ initial} + \int_0^t \left[\frac{Q}{V}(x_{A\ in} - x_A)\right] dt - x_A K \tau_r \tag{19}$$

Since the amount of injut to the reactor, Q, is a constant, we can combine Equations 3, 5, and 16 to give

$$x_{A\ in} = \left\{\frac{A + [(x_A + x_C)\,Q - P]\,(x_{A_R'} e^{-p\tau_R}}{V}\right\} \frac{e^{-p\tau_r}}{T_m p + 1} \tag{20}$$

Equation 20 can now be combined with Equation 19 to give the final equation for analytic solution. However, it is obvious from Equation 20 alone that an analytic solution will be impossible.

Fortunately, such an equation is readily solvable on electronic analog computers or on digital computers. This is discussed more fully later as part of the consideration of the control scheme for this reactor.

A CATALYTIC REACTOR—MORE COMPLEX CASE

Most catalytic reactions are not independent of temperature as we have assumed above, but are a definite exponential function of temperature such as is shown in Figure 60. Such a situation prohibits use of one over-all set of equations as before, since the heat of reaction causes a temperature variation through the reactor and a result-

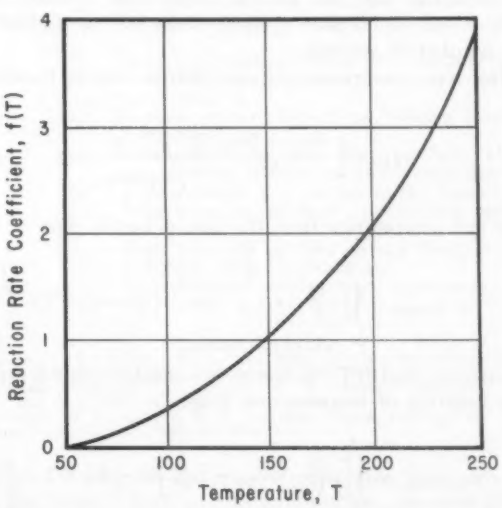

FIGURE 60—Most catalytic reaction rates are exponential functions of temperature.

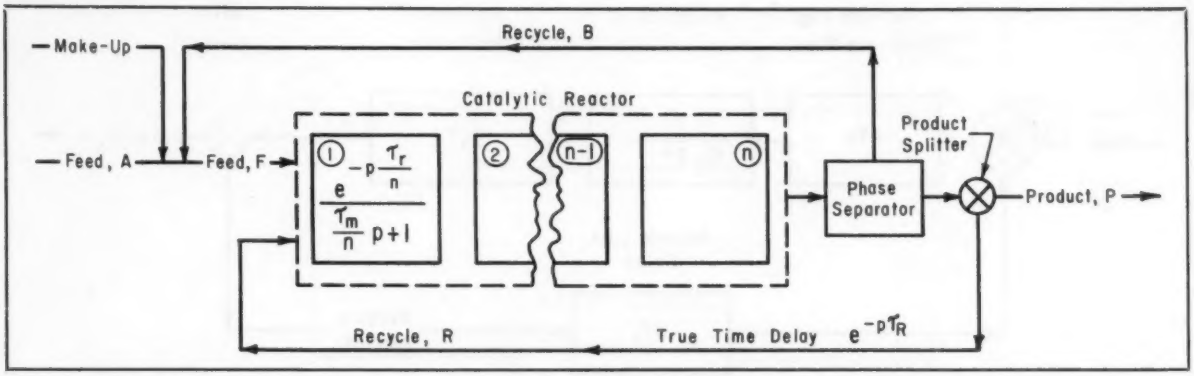

FIGURE 61—A reactor may be divided into small sections in order to consider the effects of temperature variations.

ing change in reaction rate. We must, therefore, consider the reactor as divided into a sufficient number of smaller units such that the reaction going on therein will not seriously affect the specification of the reaction rate of the next section or of other parts of the same section. Such an arrangement is shown in Figure 61. **The equations** describing mathematically the action of this more advanced case will thus have two complexing features. First, the need to determine and keep track of the temperature at various points in the reactor, and, second, the necessity for additional equations to account for the fact that the reactor is now composed of several finite sections rather than one over-all unit as before.

TABLE 1

Summary of Major Simplifying Assumptions and Their Purpose

ASSUMPTIONS	PURPOSE
1. Reaction is simple combination	To allow use of first order reaction equation
2. Component B in large excess	
3. Component B immiscible with Component A and Product C	To simplify expression of recycle composition
4. Constant throughput	To simplify expression of input composition to reactor
5. Component B makeup independently regulated	
6. Reaction coefficient is a constant (simple case only)	To permit consideration of the reactor as one unit
7. Mixing and time delay effects occur prior to reaction	To permit use of ordinary differential equations.
8. Adiabatic operation of reactor	To simplify the expression for reactor temperature

Each of the individual reactor sections can be described by a set of equations essentially the same as those previously derived. However, now that the reactor is split into sections, the residence time of each section will be equal to the total residence time divided by the number of sections. Likewise, the mixing delay time constant of a section will equal that of the whole reactor divided by the number of sections.

The input composition to the first section is, therefore,

$$x_{A_1\,in} = \left[\frac{Fx_{A_f} + Rx_{A_R}}{V}\right] \frac{e^{-p\,\frac{\tau_r}{n}}}{\frac{\tau_m}{n}p + 1} \qquad (21)$$

The exit composition from the first section is then

$$x_{A_1} = x_{A_1\,initial} + \int_o^t \left[\frac{Q}{V}(x_{A_1\,in} - x_{A_1})\right] dt - x_{A_1} f(T)\,\frac{\tau_r}{n} \qquad (22)$$

Remember that $f(T)$ is not now a constant, but is a definite function of temperature. Similarly

$$x_{A_2} = x_{A_2\,initial} + \int_o^t \left[\frac{Q}{V}(x_{A_2\,in} - x_{A_2})\right] dt - x_{A_2} f(T)\,\frac{\tau_r}{n} \qquad (22a)$$

Here

$$x_{A_2\,in} = x_{A_1}\left(\frac{e^{-p\,\frac{\tau_r}{n}}}{\frac{\tau_m}{n}p + 1}\right)$$

Therefore, the general equation of a section is

$$x_{A_n} = x_{A_n\,initial} + \int_o^t \left[\frac{Q}{V}(x_{A_n\,in} - x_{A_n})\right] dt - x_{A_n} f(T)\,\frac{\tau_r}{n} \qquad (22b)$$

and

$$x_{A_n\,in} = x_{A_{n-1}}\left(\frac{e^{-p\,\frac{\tau_r}{n}}}{\frac{\tau_m}{n}p + 1}\right)$$

The equations describing the phase separator and reflux line operation will be exactly the same as before.

We need now only consider the temperature of the various sections to define $f(T)$ to complete the derivation.

Temperature Determination. Let us allow the feed and reflux materials to enter at some base temperature, T_o, and also allow for an enthalpy of reaction of H in BTU's per unit volume, and an average heat capacity of the mixture of C_p in BTU's per unit volume per degree. Again for the sake of simplicity in our derivation, assume adiabatic operation of the reactor. Now

$$T_1 = T_o + \left(\frac{V}{n}\,x_{c_1}\right)\frac{H}{\frac{V}{n}C_p}$$

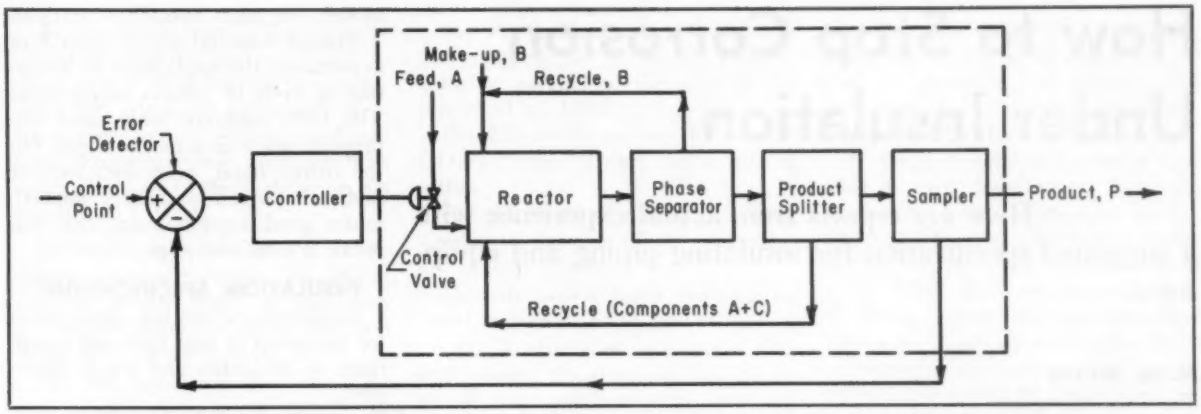

FIGURE 62—A chemical reaction may be controlled by regulating the amount of one of the feed components.

$$= T_o + \frac{x_{c_1} H}{C_p} \qquad (23)$$

while

$$T_2 = T_1 + (x_{c_2} - x_{c_1}) \frac{H}{C_p} \qquad (23a)$$

and finally

$$T_n = T_{n-1} + (x_{c_n} - x_{c_{n-1}}) \frac{H}{C_p} \qquad (23b)$$

Depending upon the method of solution which one wishes to use, the function of $f(T)$ may be expressed as an algebraic function of T, be retained in graphical form as in Figure 60, or be expressed as a set of tables. In case a digital computer is to be used, the first method is necessary. For analog computers the second is usually easiest to use, while if hand numerical methods were to be used, the latter would be most convenient.

Table 1 summarizes the assumptions we have made in this development along with the reasons why we have considered them. It is to be emphasized that most of these assumptions could be disregarded if one is willing to accept the more compex analysis which will then result.

THE REACTOR IN A CONTROL LOOP

Because of the positive feedback caused by the reflux loop an upset in the reactor can be self-perpetuating depending upon the ratio of reflux to throughput and upon the nature of the upset. A major requirement for control of the reactor is therefore the smoothing out of such fluctuations. Two possibilities present themselves immediately for such control. We may either change the amount of product takeoff or conversely, change the amount of component A input to the process.

The position of the process in the control loop for the case of control on the component A input is shown in Figure 62. Now that the equations describing the reactor have been derived, the investigation of the nature of the proper control for this process can be carried exactly as specified for the heat exchanger described in Part 9 of this series, or for the distillation column discussed elsewhere.[3] That is, the complete set of equations as given here is entered along with the corresponding controller equations into the electronic differential analyzer and various control parameters are investigated by means of computer solutions until the best set of control functions is found.

Unlike the heat exchanger of Part 9, the particular set of equations as derived here have not been solved by the present author to date. However, a somewhat similar reactor system has been solved by Batke, Franks and James[1] with excellent results. Their paper is recommended to the reader for a further discussion of the analysis of problems of this type.

SYMBOLS USED

A	The reactant material in smallest concentration.
$\bar{A}$	Input rate for component A in unit volumes per unit time.
B	The reactant material in largest concentration.
C	Product component.
C_p	Heat capacity.
F	Feed rate in unit volumes per unit time.
f(T), K	First order reaction coefficient.
H	Enthalpy of reaction in BTU's per unit volume reacted.
n	Number of sections into which reactor is divided for analytical purposes.
O	Output rate in unit volumes per unit time.
P	Product takeoff rate in unit volumes per unit time.
Q	Throughput rate in unit volumes per unit time.
R, R″	Recycle rate of components A and C.
R′	Output rate of components A and C.
T	Temperature.
t	Time.
V	Volume of reactor.
x	Volumetric concentration, first subscript designates component, second subscript if present denotes location of stream.
$x_{A\ in}$	Input volumetric concentration, component A.
$x_{A\ initial}$	Initial composition of liquid in reactor, component A.
$x_{A\ out}$	Output volumetric composition, component A.
x_{A_f}	Feed composition as volume fraction of component A.
x_{A_R}	Recycle composition as volume fraction component A.
$x_{A_{R'}}$	Composition of exit stream from phase separator as volume fraction component A.
τ_m	Time constant for mixing in the reactor.
τ_R	True time lag of fluid in traveling recycle line.
τ_r	True time lag of fluid in the catalyst bed, residence time for reaction.
1, 2, 3, . . . , n	As subscripts denote particular section of the reactor.

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[1] Batke, T. L., Franks, R. G., and James, E. W., *Proceedings of the Instrument Society of America*, 11, Paper 56-7-2, (1956).

[2] Daniels, Farrington, and Alberty, R. A., *Physical Chemistry*, John Wiley and Sons, New York, 1955, pp. 320-325.

[3] Williams, T. J., Harnett, R. T., and Rose Arthur, *Industrial and Engineering Chemistry*, 48, (1956) pp. 1008-19.

This is the last in the present group of articles concerning the control loop and its components. Another group of articles on "Automation Today" will begin in a later issue of PETROLEUM REFINER.

How to Stop Corrosion Under Insulation

Here are reports from actual experience with a suggested specification for insulating piping and equipment.

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PRACTICALLY EVERYONE agrees that the corrosion of steel under insulation is primarily caused by oxygen and moisture. At temperatures below the dew point, condensation will occur on steel surfaces when water vapor penetrates porous insulations. Rain water can contact the steel surface through cracks caused by expansion and contraction of the insulation or failure of the bands, reinforcing, etc.

As one refiner states: "In a general way, the severity of corrosion under all types of insulation has been observed to be proportional to the amount of water present. In the most severe cases, the insulation is found to be soggy and saturated with water."

Four companies furnished experience reports of corrosion of towers and vessels occurring under insulation. Some of their problems and solutions are shown in Table 1.

From these actual experiences, it is evident that water is entering the insulation around the vessel's exterior connections, such as nozzles, manways, and angle supports. This leakage is possibly caused by the insulation shrinking from these connections and the lack of proper flashing.

It is interesting to note that in some cases the vessels were painted and the insulation omitted in order to remedy this corrosion hazard. However, such a remedial measure is not desirable in operating units because an uninsulated tower will require constant control adjustments with weather changes.

In considering solutions to problems of corrosion under insulation, the first approach would logically be the suggested application of a protective coating to the vessel in order to protect it from the wet insulation. However, wet insulation has a low thermal efficiency and a rapid deterioration of the insulation attachment may be expected. Thus, a better solution to the problem is to provide a means of keeping the insulation dry.

In order to maintain dry insulation, the best weatherproofing material available should be specified. Consideration should also be given to the type of insulation attachment that will be used. The ordinary galvanized poultry wire mesh, bands and other attachments may require a substitute, corrosion resistant material, such as monel, for high humidity locations.

Though material specification is of importance, the application of insulation is even of greater importance. The best materials when used improperly result in a mediocre job. On the other hand, even with inferior materials, when properly applied, under good supervision, one can obtain a satisfactory job.

About the Author

H. M. WILTEN is with The Texas Co., Port Arthur, Texas. He holds a B.S. degree in mining and metallurgical engineering from the University of Illinois, and was an instructor in these subjects for one year at the University of Seattle. For 18 months he was engaged in hydrometallurgy of copper for Union Miniere du Haut Katanga, Belgium Congo; and was a metallurgist for American Steel Foundries, Ohio Steel Foundry Co., and Republic Steel Corp. Since 1930 he has been in the metallurgical department of The Texas Co.'s Port Arthur refinery.

INSULATION SPECIFICATION*

Suggested engineering specification for insulation of pipe lines and equipment of 36 inches and less in diameter.

Scope. The suggested practice covers methods of application for the insulation of pipes, vessels and other equipment in the temperature range, atmospheric to 250 F.

Preparation of Surfaces

1. All metal surfaces shall be thoroughly cleaned of grease, dirt, rust and scale by sandblasting or by using metal brushes and scrapers.

2. When cleaned and dry, the metal surfaces shall be painted with a rust inhibiting paint, i.e. red lead inhibited with zinc chromate.

3. Insulated equipment that operates at or below ambient temperature should have a mastic of 15 pound doped felt, or equal, applied over the primer.

Material

1. Insulation for pipes and vessels operating to 600 F shall be 85 percent magnesia, or equal. The insulation shall be furnished in the forms and shapes best suited to the work.

2. The thickness of insulation to be applied for heat conservation at various temperatures shall be in accordance with standard industry practices.

3. The necessary material needed to hold the insulation in place will be specified in the following section under application.

Application

1. Piping shall be insulated with sectional-moulded pipe covering applied with all joints tightly butted and pointed with insulating cement of the same type as the insulation itself. When double layer insulation is used, the outer layer shall be applied over the inner layer in such a manner that all joints are offset.

* Although this information was gathered under the auspices of the Subcommittee of Corrosion, Division of Refining, American Petroleum Institute, it should not be construed as recommending or suggesting any standard or generally accepted practice for the industry.

2. The inside layer of double layer insulation shall be fastened firmly in place with a minimum of two galvanized tie wires or galvanized steel bands per section. When wires are used, the twisted ends are to be bent down flush with the surface of the insulation.

3. Single layer insulation and the outside layer of two layer insulation, shall be fastened firmly in place with galvanized tie wire or galvanized steel bands of the gage specified below.

(a) For insulation 8 inches OD and smaller, tie wires or bands, 18 gage, shall be spaced not over 12 inches apart. On insulation 8 inches OD to 11 inches OD, the ties, 16 gage, shall be spaced not over 9 inches apart. On insulation larger than 11 inches OD, tie wires of 14 gage shall be used.

(Note: If corrosion environment justifies, greater corrosion resisting material for wires and bands may be specified; such as, type 420 stainless steel, type 302 stainless steel or monel.)

4. Outdoor pipe insulation shall be covered with asphalt-saturated 55 pound asbestos weatherproofing felt.

(a) For insulation 6½ inches OD and smaller, the joints of weather covering parallel to the axis of the pipe shall lap 120 degrees.

(b) For insulation over 6½ inches OD, the covering shall lap at least 6 inches.

(c) All joints of covering perpendicular to the axis of the pipe shall lap at least 3 inches.

(d) All lapped joints shall be located and arranged to shed rainfall.

(e) On insulation 6½ inches OD and smaller, the covering shall be secured with galvanized tie wire or bands on 6 inch centers. For insulation larger than 6½ inches OD, the wires or bands will be spaced on 8 inch centers. All twisted ends of the tie wires shall be bent flush with but not cutting into, the covering.

5. Insulation located indoors shall be finished with an 8 oz. canvas jacket pasted neatly in place with laps located so as to be least visible.

6. When specifically called for, pipe insulation shall be covered with 28 gage galvanized steel or aluminum. When the latter is used, a moisture proof barrier shall be applied between the insulation and the aluminum sheet. For all piping located below 20 feet in elevation, aluminum .024 inch thick and above 20 feet, aluminum .016 inch thick shall be used.

7. When aluminum insulation covering is used, longitudinal joints on horizontal runs shall be approximately 45 degrees below the horizontal center line of the pipe and lapped to shed water. With plain aluminum sheets, all joints, longitudinal and girth, shall have a minimum lap of 3 inches. With corrugated aluminum covering, longitudinal joints shall be lapped a minimum of 5 corrugations and girth joints shall have a minimum lap of 3 inches. Joints should be preferably fastened with aluminum screws (stainless steel screws may also be used) on not less than 4 inch centers or the entire section may be secured with a ¾ inch wide circumferential aluminum strap, spaced not more than 6 inches apart.

(Note: For a moisture barrier under aluminum, 15 pound asbestos, saturated felt shall be used.)

ACKNOWLEDGMENT

The assistance of personnel of the various companies represented on the Subcommittee on Corrosion, Division of Refining, American Petroleum Institute, is gratefully acknowledged.

TABLE 1—Eight Corrosion Problems Under Insulation and How They Were Solved

Item No.	Vessel	Service	Oper. Temp.	Age of Equipt.	Time in Oper.	Description of Insulation	Primed	Painted	Description of Attack	Remedial Measures or Remarks
1	3-Storage Tanks	Lubricating Oil Additives	150 F.	5 yrs.	.....	1" thick 85% Magnesia layer asbestos cement galvanized wire mesh asphalt emulsion weatherproofing and coat of black paint.	No	No	Heavy rusting and pitting, shell of one tank had many holes.	On rebuilding outside surface was sandblasted and one coat of lead chromate primer was sprayed on. Two coats of cork filled mastic, each ⅛" thick, were sprayed for protection and insulation.
2	Desalter Sphere	Houdry Unit	220 F.	3½ Yrs.	.....	1" thick 85% Magnesia block layer of asbestos cement, galvanized wire mesh, heavy troweled coat of bituminous mastic.	No	No	Corrosion more severe in lower portion. Heavy rusting estimated metal loss⅜" thick. Maximum depth of pits up to ¼".	Sandblasted sprayed one coat of lead chromate primer. Following paint system applied: one coat zinc chromate-iron oxide alkyd, one coat titanium base alkyd gray, one finish coat varnish type aluminum—did not reinsulate.
3	Deisobutanizer Tower	Alkylation Plant	160 F.	11 Yrs.	.....	Bottom ⅔ of tower rock wool galv. wire mesh asbestos cement, asphalt emulsion and finish coat of aluminum paint. Top ⅓ was reinsulated several years ago with 85% Magnesia block and similar weatherproofing.	.....	.....	Heavy rust scale over most of the vessel, particularly at insulation support angles.	Surface cleaned by scraping and brushing. Inhibited penetrating oil type metal preparation solution used. Brush applied one coat lead chromate, primer sprayed second lead chromate, sprayed finish coat of aluminum paint. Did not reinsulate.
4	Butane Storage Spheroids	.....	57 F.	7 Mos.	.....	Foam glass block impaled on Nelson studs over sandblasted lead chromate primed, mastic protective coated surface. Outer mastic weather seal and finish coat of aluminum paint.	Yes	.....	Corrosion of Nelson studs and speed clips. Slight rust on surface of primer coat near base of studs.	Spray applied two coats of mastic weather seal with glasfab reinforcement over existing insulation, sprayed one finish coat of aluminum paint.
5	Debutanizer Tower	Thermofor Catalytic Plant	.....	8 Yrs.	.....	.....	.....	.....	Found corrosion losses of ⅛" at the insulation support angles.	In two areas of excessive corrosion ⅛" plug welded rings were applied to the tower. After sandblasting painted with red primer and new insulation with metal jacketing was installed.
6	Bubble Tower	.....	Atmospheric	6 Yrs.	90%	3" Magnesia block	Yes	Yes	Tower OK, mesh very rusty.	.....
7	Bubble Tower	.....	145 F.	3 Yrs.	90%	1" Rock wool blanket	Yes	No	Tower rusty ⅛" scale bands and mesh very rusty.	.....
8	Bubble Tower	.....	170 F.	3 Yrs.	90%	1" Rock wool blanket	Yes	No	Tower rusty band corroded through, mesh rusty and weak.	.....

How to Calculate Tube Sheet

Here's a simple method that does not involve approximations, tabulated values or educated guesses and can be applied to any type of tube layout. Special design equations are given for both single pass units and "U" tube units.

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THE DESIGN of heat transfer equipment frequently involves the estimation of the size of tube sheet required to accommodate a given number of tubes on various spacings. In the course of any design, it may be necessary to make several trial tube sheet layouts before the design can be established. Many approaches are available to the designer, such as tabulated values of prior tube counts, an approximation based upon equivalent lattice areas, an educated guess or having a draftsman make a layout for each condition to be investigated. Most of these procedures are either too approximate or time consuming for good engineering usage.

This article presents a method which is simple and in principle can be applied to any type of tube layout. Because the detailed calculations are tedious and time consuming, emphasis has been placed on equilateral triangular tube spacings. Curves derived from the aforementioned calculations have been found to have more than adequate accuracy for design purposes and enable the designer to very quickly establish the feasibility of any set of design parameters. The cases for which equations and detailed calculations have been made are:

- Single pass unit with tube on center.
- Single pass unit with tube off center.
- "U" tube unit with tube on center.
- "U" tube unit with tube off center.

CASE 1—Single Pass Unit—Tube on Center

Equilateral Triangular Pitch. A typical layout of this arrangement is shown in Figure 1. The parameters that enter this calculation are the radius to the center of the outermost tube and the tube spacing or pitch. The row numbering scheme used, as well as the radius to the outermost tube and the tube pitch are shown on Figure 1. In order to derive the necessary equations in a convenient manner the quardrant tube layout is divided into three parts; the horizontal diameter, the vertical diameter and a typical tube row such as Q_n. Since the mathematical equations are continuous and the number of tubes increase (or decrease) in discontinuous steps, certain modifying rules must be developed in each case in order to obtain correct tube counts. Since these rules, once stated, are self-evident they will merely be tabulated in each case after the equation for the case has been developed.

Proceeding in the above manner for Case 1, one obtains the following:

The number of tubes in the horizontal diameter is:

$$2\left[\frac{R}{P}\right]+1 \qquad (1)$$

The number of tubes in the vertical diameter is (the center tube has been included in Equation (1)):

$$2\left[\frac{R}{\sqrt{3}P}\right] \qquad (2)$$

The number of tubes contained in a typical quarter chord of row Q_n is equal to the chord divided by the pitch. Mathematically, this equals:

$$\sqrt{\left(\frac{R}{P}\right)^2-\frac{3}{4}Q_n^2} \qquad (3)$$

Each of these quarter chord tubes has to be summed

Diameters

to Q_n and multiplied by 4. Doing this and summing Equations (1), (2) and (3) yields the desired expression for the tube count for this case:

$$N = 4\left[\sum_{Q=1}^{Q=n}\left(\sqrt{\left(\frac{R}{P}\right)^2 - \frac{3}{4}Q_n^2}\right)\right] + \left[2\left(\frac{R}{P}\right)+1\right]+2\left[\frac{R}{\sqrt{3}\,P}\right] \quad (4)$$

The required rules previously mentioned are:

1. If n is even (Q_2, Q_4, Q_6) and the square root is a decimal, use the next lowest integer before multiplying by 4.
2. If n is odd (Q_1, Q_3, Q_5) and the square root is equal to or greater than 0.5, use the next highest integer before multiplying by 4.
3. If in the second term of Equation (4), $\frac{R}{P}$ is a decimal, use the next lowest integer before multiplying by 2 and then add 1.
4. If in the third term of Equation (4), $\frac{R}{\sqrt{3}\,P}$ is a decimal, use the next lowest integer before multiplying by 2.

The above set of rules account for the discontinuities that physically exist and enable one to use Equation (4) which in a mathematical sense is continuous.

CASE 2—Single Pass Unit With Tube Off Center

Equilateral Triangular Pitch. A typical layout for this case is shown in Figure 2. The reasoning leading to Equation (4) for Case 1 above is the same as for Case 2. The equation for the tube count appears to be very nearly the same except for the term involving the number of tubes in the horizontal diameter. For Case 2, there is no tube in the center and, therefore, there is one less tube than that given by Equation (1). With this in mind, the tube count for Case 2 becomes:

$$N = 4\left[\sum_{Q=1}^{Q=n}\sqrt{\left(\frac{R}{P}\right)^2 - \frac{3}{4}Q_n^2}\right] + 2\left(\frac{R}{P}\right)+2\left[\frac{R}{\sqrt{3}\,P}\right] \quad (5)$$

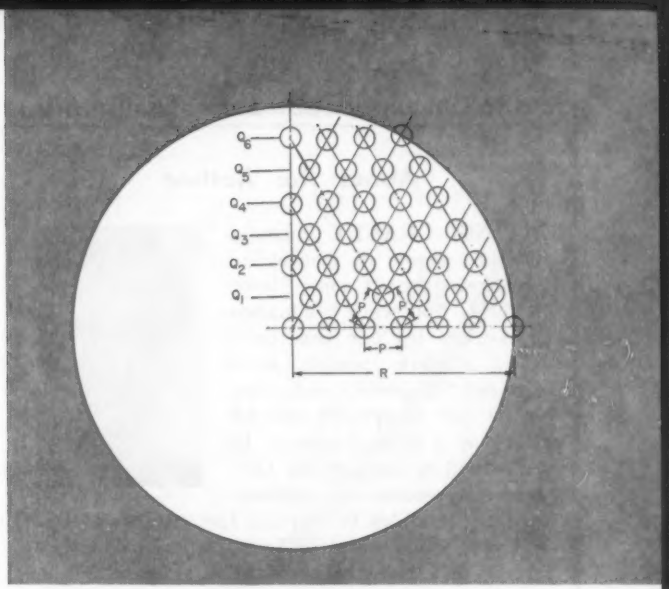

FIGURE 1—Single pass design with tube on center.

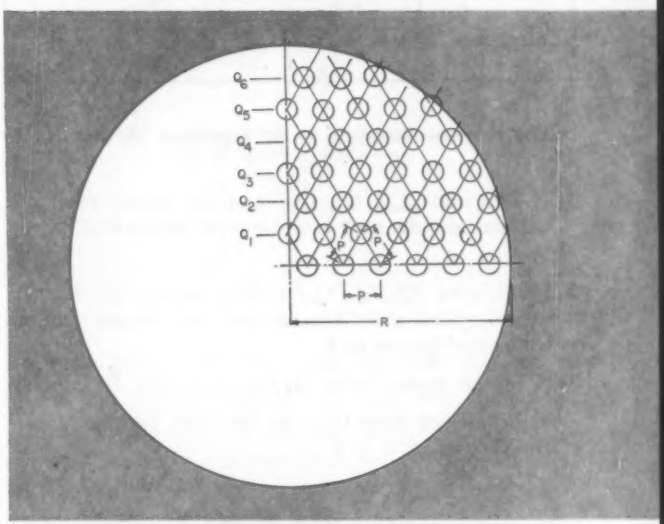

FIGURE 2—Single pass design with tube off center.

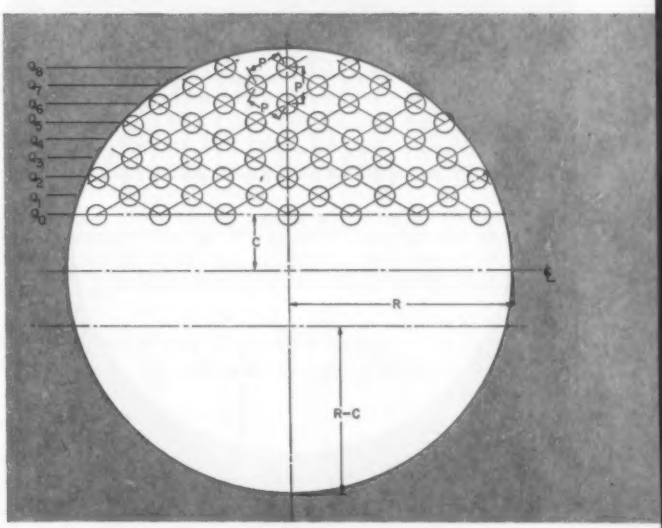

FIGURE 3—"U" tube design with tube on vertical center.

About the Author

IRVING GRANET received his B.S. degree in mechanical engineering from Cooper Union in 1944. Following graduation he worked for one year on a Navy Torpedo project as a project engineer, and then served two years with the Air Force as a flight engineer. In June 1948 he received his M.S. degree in mechanical engineering from Brooklyn Polytechnic Institute. Since 1947 he has been employed by Foster Wheeler and after serving in various capacities is now consultant in the Nuclear Energy department in New York. Granet has taught heat transfer and thermodynamics at Brooklyn Polytechnic, and has published more than 20 articles.

The rules necessary to make Equation (5) applicable are:

1. If n is odd (Q_1, Q_3, Q_5) and the square root is a decimal, use the next lowest integer before multiplying by 4.
2. If n is even (Q_2, Q_4, Q_6) and the square root is equal to or greater than 0.5, use the next highest integer before multiplying by 4.
3. If in the second term of Equation (5), $\frac{R}{P}$ is equal to or greater than 0.5, use the next highest integer and then multiply by 2.

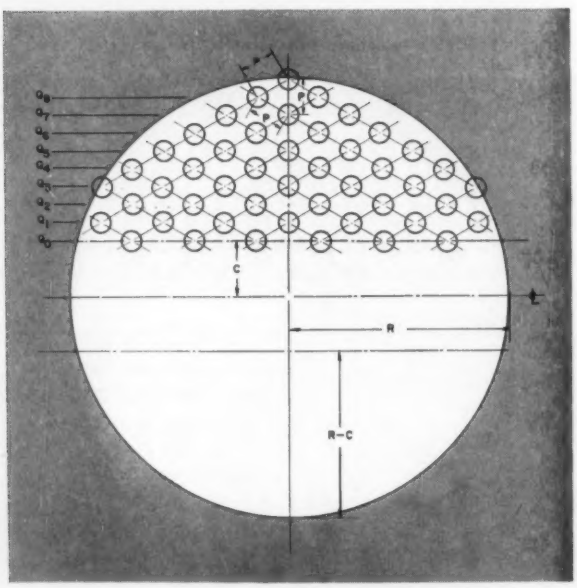

FIGURE 4—"U" tube design with tubes off vertical center.

4. If $\frac{R}{\sqrt{3}\,P}$ in the third term of Equation (5) is a decimal equal to or greater than 0.5, use the next highest integer and then multiply by 2.

CASE 3—"U" Tube Unit With Tube on Center

Equilateral Triangular Pitch. From practical considerations, it is desirable to bend tubes to radii which increase in uniform fractions of an inch rather than to radii that increase in unusual decimal fractions of an inch; e.g. by the $\frac{\sqrt{3}}{2}P$. Therefore, it will be noted that the layout indicated in Figure 3 shows the tube layout in a different aspect than shown in Figures 1 and 2. This is done to keep the radii either integer multiples of the pitch or multiples of half the pitch. The "C" dimension accounts for the minimum radius of tube bend and/or the thickness of pass partition, whichever governs. Proceeding as before, the vertical centerline and a typical chord are considered. Note that each tube has two holes in the tube sheet.

The number of tubes on the vertical centerline is:

$$\left[\frac{R}{P}-\frac{C}{P}\right]+1 \qquad (6)$$

The length of a typical quarter chord divided by the spacing of the tube along the chord is:

$$\frac{\sqrt{R^2-\left[Q_n\frac{2}{P}+C\right]^2}}{\sqrt{3}P}=\sqrt{\frac{1}{3}\left(\frac{R}{P}\right)^2-\frac{Q_n^2}{12}-\frac{Q_n}{3}\left(\frac{C}{P}\right)-\frac{1}{3}\left(\frac{C}{P}\right)^2} \qquad (7)$$

Adding Equations (6) and (7) and summing:

$$N=\left[\frac{R}{P}-\frac{C}{P}\right]+1+2\left[\sum_{Q=0}^{Q=n}\left(\sqrt{\frac{1}{3}\left(\frac{R}{P}\right)^2-\frac{Q_n^2}{12}-\frac{Q_n}{3}\left(\frac{C}{P}\right)-\frac{1}{3}\left(\frac{C}{P}\right)^2}\right)\right] \qquad (8)$$

The rules for this case are as follows:

1. If $\left(\frac{R}{P}-\frac{C}{P}\right)$ is a decimal, use the next lowest integer.
2. If n is even (Q_0, Q_2, Q_4) and the square root is a decimal, use the next lowest integer before multiplying by 2.
3. If n is odd (Q_1, Q_3, Q_5) and the square root is equal to or greater than 0.5, use the next highest integer before multiplying by 2.

CASE 4—"U" Tube Unit With Tube Off Center

Equilateral Triangular Pitch. This layout, as shown in Figure 4, is similar to the previous case except that the entire pattern has been displaced horizontally. The only alteration to Equation (8) is the fact that a tube does not exist on center (as defined in Figures 3 and 4). Therefore, the tube count is given by Equation (9) for Case 4.

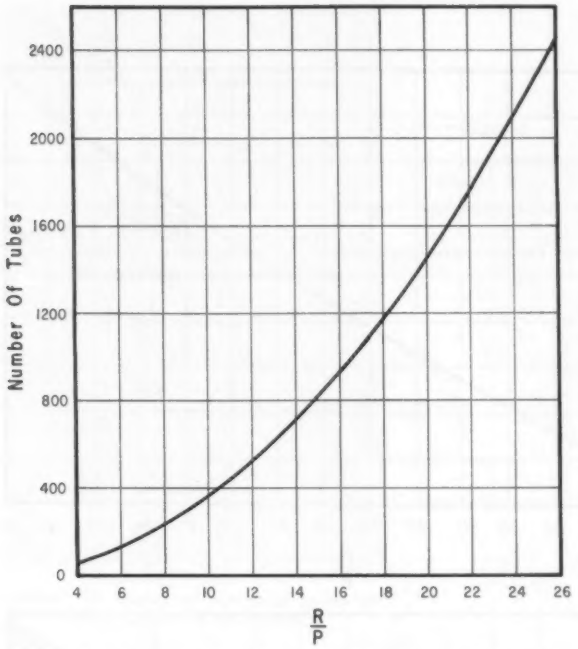

FIGURE 5—Tube count for tubes on equilateral triangular centers. Tube on center, single pass design.

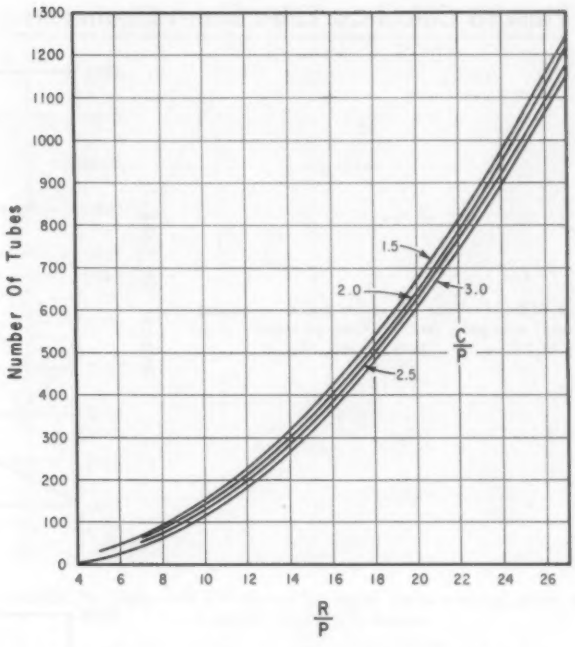

FIGURE 6—Tube count for tubes on equilateral triangular centers. Tube on center, U tube design.

$$N=\left[\frac{R}{P}-\frac{C}{P}\right]+2\left[\sum_{Q=0}^{Q=n}\left(\sqrt{\frac{1}{3}\left(\frac{R}{P}\right)^2-\frac{Q_n^2}{12}-\frac{Q_n}{3}\left(\frac{C}{P}\right)-\frac{1}{3}\left(\frac{C}{P}\right)^2}\right)\right] \quad (9)$$

It is interesting to note that for the single pass cases considered, the number of tubes is a unique function of the ratio $\frac{R}{P}$. This follows from the fact than n, the number of rows along a radius, is only a function of this same ratio, $\frac{R}{P}$. Similarly, for the "U" tube arrangements, the tube counts are unique functions of only the ratios $\frac{R}{P}$ and $\frac{C}{P}$. Using a tabular type of calculation procedure, the tube counts for each of the four cases considered have been calculated over a range of $\frac{R}{P}$ and $\frac{C}{P}$ values of practical interest. From these calculations, two observations can be made:

1. For practical design purposes, the on center and off center arrangements yield essentially the same results. Actually, there is a difference between the tube counts but the difference is relatively small. For a final layout (especially in a "tight" design), both should be investigated since one cannot predict which will yield the higher count unless extensive tables are developed from the equations of this paper. The calculations made were for integer values of $\frac{R}{P}$ and even these were long and tedious.

2. At low values of $\frac{R}{P}$ the tube counts appear to be discontinuous and jump in unequal steps. This is because the patterns at these values are essentially hexagons which increase in discreet, relatively large steps rather than continuously.

On the basis of the foregoing, the writer has not included the lowest values of $\frac{R}{P}$ and only two sets of curves are presented for the four cases examined in this paper. These curves, Figures 5 to 8, have been found to be essentially exact for practical design use.

EXAMPLE

The following example will serve to illustrate the use of these curves.

Determine the minimum channel I.D. for a heat exchanger under the following conditions:

1. Single Pass—2600 1-inch O.D. tubes on 1¼-inch equilateral triangular centers.
2. Single Pass—5200 ½-inch O.D. tubes on ¾-inch equilateral triangular centers.
3. "U" Tube—2600 ½-inch O.D. tubes on ¾-inch equilateral triangular centers.

For each of the above, assume the spacing from the edge of the outermost tube to the tangent point of the channel to cylinder radius is ¼ inch minimum. Also, assume this radius to be ¾ inch minimum. Solve each of the above in the following manner:

a. Using the equivalent lattice concept with each tube taken to occupy a fixed area of the tube sheet.

b. Same as (a), except a 90 percent factor to be used for clearance.

c. Using Figures 5 to 8.

For the "U" tube case, take $\frac{C}{P}=2$.

1. (a) Area/tube $= 0.866\ P^2 = 0.866 \times 1.25^2 = 1.355$ sq. in. per tube.

$2600 \times 1.355 = 3520$ sq. in.

$\frac{\pi}{4} D^2 = 3520$

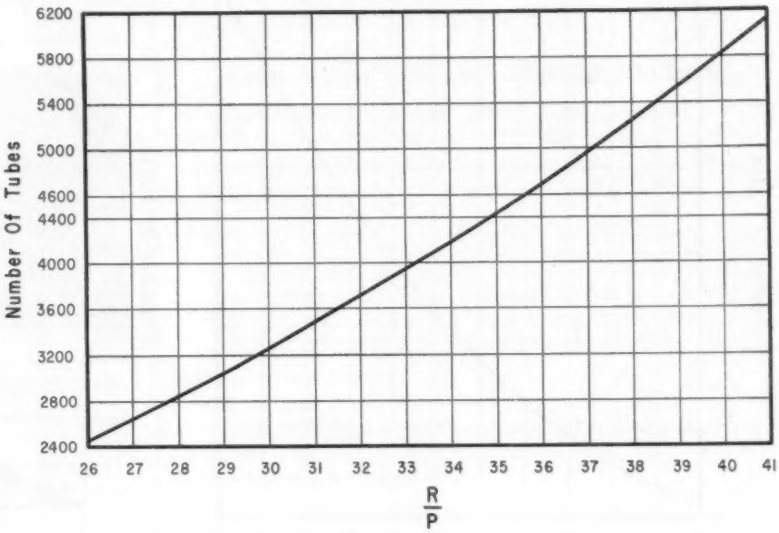

FIGURE 7—Tube count for tubes on equilateral triangular centers. Tube on center, single pass design.

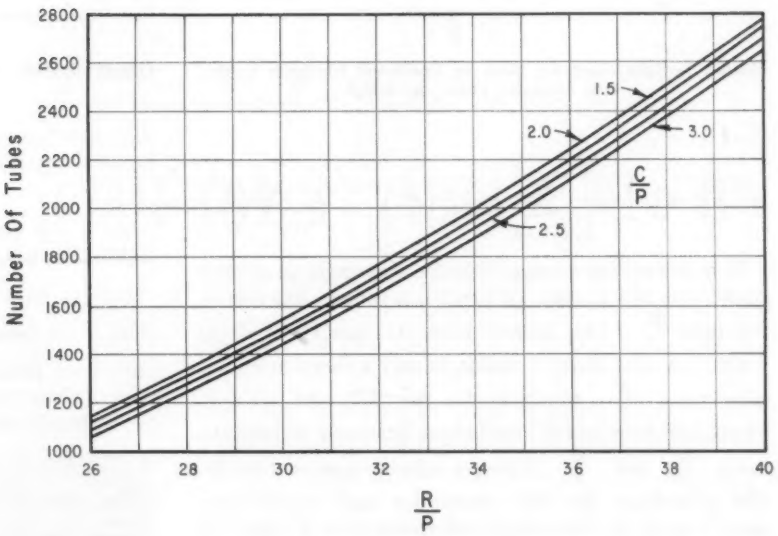

FIGURE 8—Tube count for tubes on equilateral triangular centers. Tube on center, U tube design.

$D \cong 66.8$ inches—say 67 inches.

(b) From (a) $\frac{\pi}{4} \times D^2 \times .90 = 3520$

$D \cong 70.5$ inches—say 71 inches

(c) For 2600 tubes (single pass) $\frac{R}{P} = 26.7 +$ (Figure 6).

$R = 1.25 \times 26.7 = 33.4$

To this it is necessary to add the clearance from the tube edge and the fillet radius. Since R is to the center of the tube, it is also necessary to add the tube radius. Proceeding in this manner:

$D = 2\ [33.4 + 0.5 + 0.25 + 0.75] = 69.8$ inches

Say $D \cong 69\frac{3}{4}$ inches or 70 inches for design purposes.

2. (a) As before, $0.866\ P^2 = 0.886 \times \left(\frac{3}{4}\right)^2 = 0.487$ sq. in./tube

Area required $= 5200 \times 0.487 = 2530$ sq. in.

$\frac{\pi}{4} D^2 = 2530$

$D \cong 56.6$ inches—say 57 inches

(b) $\frac{\pi}{4} D^2 \times 0.9 = 2530$

$D \cong 59.7$ inches—say 60 inches

(c) For 5200 tubes (single pass) $\frac{R}{P} = 38 —$ (Figure 6)

$R = 0.75 \times 38 = 28.5$ inches

And as for Part 1(c), $D = 2\ [28.5 + 0.25 + 0.25 + 0.75] = 59.5$—say $59\frac{1}{2}$ inches

3. (a) From 2(a), area required for tubes (5200 ends) = 2530 sq. in.

$\frac{C}{P} = 2$; $2C = 3$ inches

The area occupied by this clearance = 3D (to a first approximation).

$\frac{\pi}{4} D^2 = 2530 + 3D$

Solving $D \cong 58.6$ inches

(b) $\frac{\pi}{4} D^2 \times 0.9 = 2530 + 3D$

$D^2 = 3580 + 4.25D$

$D \cong 61.9$ inches—say 62 inches

(c) $\frac{R}{P} = 39 —$ (Figure 8); $R = 29.25$ for 2600 ½-inch O.D. tubes on ¾-inch equilateral triangular pitch.

$D = 2\ [29.25 + 0.25 + 0.25 + 0.75] = 61$ inches

ACKNOWLEDGMENT

The author wishes to acknowledge the invaluable aid of Miss Margaret Moran in performing the detailed calculations for this work.

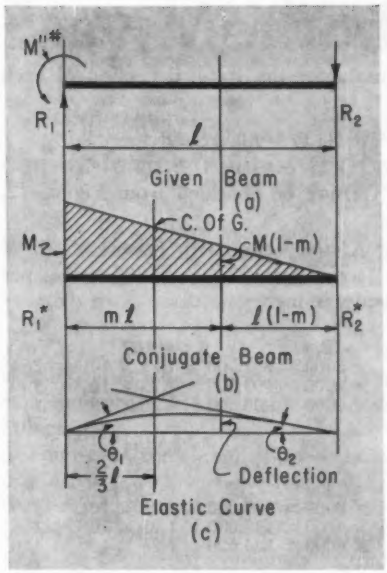

FIGURE 19—Given and conjugate beams reacting under an applied couple.

TABLE 8

Value of m	Value of G
.1	4.10
.2	6.91
.3	8.57
.4	9.22
.5	9.0
.6	8.06
.7	6.55
.8	4.61
.9	2.38
1.0	0

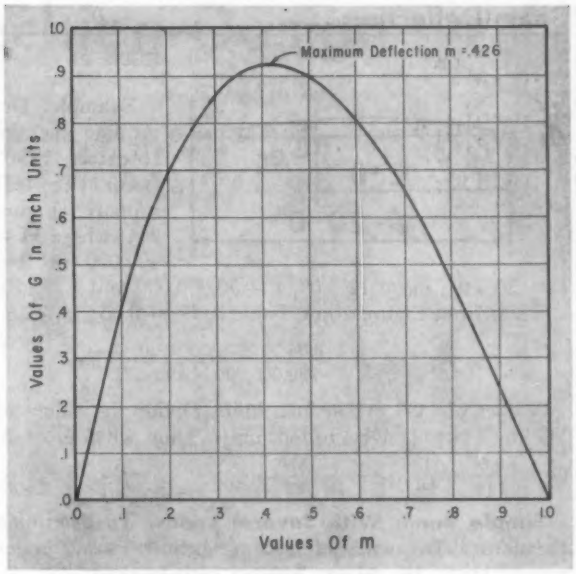

FIGURE 20—Deflection coefficients for simple beam reacting under a couple applied to the left support.

Easy Method to Get Beam Deflection

Here's an easy way to solve these beam problems involving applied couples and restrained beams.

Charles H. Fork, Ralph M. Parsons Company, Los Angeles

THE FIRST TWO PARTS of this series described simple methods of determining areas of moment diagrams, deflection of simple beams reacting under a uniform load, deflection under concentrated loads and the deflection of cantilever beams reacting under uniform loading. This article will describe easy methods of determining the effect of applied couples to simple beams, the deflection when a couple is applied to simple beams, simple beams reacting under several concentrated loads and the deflection of restrained beams.

Applied Couple, Simple Beam. To determine the applied couple at the left support, for a simple beam (Figure 19), the angular deflection (Θ) must first be derived:

From fundamental principles:

$$\Theta_1 = \frac{R_1^*}{EI} \text{ and } \Theta_2 = \frac{R_2^*}{EI}$$

That is, the angular deflection at the supports is equal to the reaction of the conjugate beam divided by EI.

$d = \frac{M^*}{EI}$ or, the deflection at any point is equal to the bending moment of the conjugate beam divided by EI.

$$R_1^* = \frac{Ml}{2} \cdot \frac{2}{3} = \frac{Ml}{3} \text{ and } R_2^* = \frac{Ml}{6}$$

$$\text{Then, } \Theta_1 = \frac{Ml}{3\,EI} \quad \text{.....Equation 19}$$

$$\text{And, } \Theta_2 = \frac{Ml}{6\,EI} \quad \text{.....Equation 20}$$

The bending moment at ml distance from the left support is:

$$M^* = \frac{Ml}{6} \cdot l\,(1-m) - M\,(1-m) \cdot l\left(\frac{1-m}{2}\right)\frac{1}{3}l\,(1-m)$$

$$\text{or, } M^* = Ml^2\left[\frac{(1-m)-(1-m)^3}{6}\right]$$

Multiplying the coefficient of Ml^2 by 144, reducing to inch units and allowing this expression to be denoted by "G", then $G = \frac{144}{6}[(1-m)-(1-m)^3]$

$$\text{Then } BM^1 = GMl^2$$

$$\text{Then } d = \frac{GMl^2}{EI} \quad \text{.....Equation 21}$$

Values of "G" have been calculated for values of m ranging from 0 to 1.0. They are found in Table 8 and are shown on the graph in Figure 20. *Continued on Next Page*

Part 3

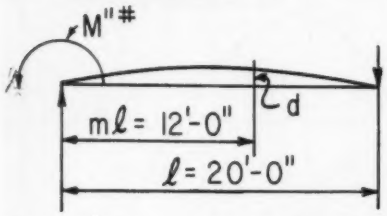

FIGURE 21

Example: Determine the deflection 12'-0" from the left support (Figure 21), where M = 200,000 in lbs., l = 20' - 0", ml = 12' - 0", E = 30,000,000 and I = 125. Then from Figure 20 or Table 8, G = 8.06

$$\text{Therefore } d = \frac{8.06 \times 200{,}000 \times 20}{30{,}000{,}000 \times 125} = .172$$

Values of "G" are in inch units. Divide the values of "G" by 144 to convert to foot units. Thus, when m = .5,

$$G = \frac{9.0}{144} = \frac{1}{16} \text{ or } d = \frac{1}{16}\,\frac{Ml^2}{EI}$$

Simple Beam With Several Loads. To determine the natural frequency of a simple beam reacting under several loads, the energy method may be used.

TABLE 9

LOAD	y	y^2	P_y	$P_y y$	$\frac{P_y}{P_y y}$
P_1=8000	.497	.247	3970	1975	2.01
P_2=4000	.581	.326	2322	1305	1.78
P_3=6000	.366	.134	2200	816	2.70

$$\Sigma \frac{P_y}{P_y y} = 6.49$$

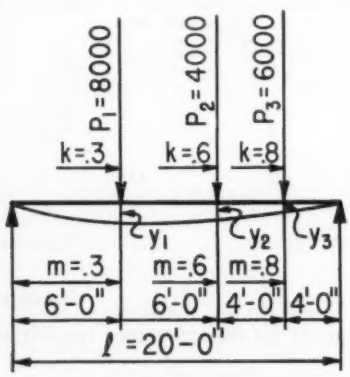

FIGURE 22—Simple beam reacting under several concentrated loads.

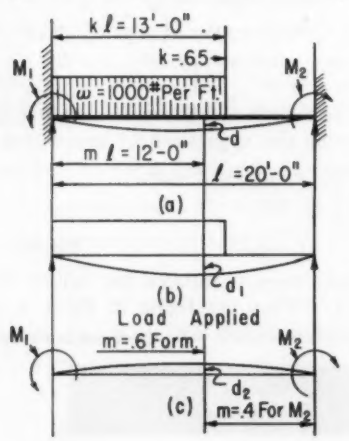

FIGURE 23—Simple, restrained beam, uniformly loaded over part of the span.

$$fn = \frac{1}{2\pi}\sqrt{\frac{g\Sigma P_y}{\Sigma P_y^2}} \text{ cycles per second.}^1$$

The general formula for the static deflection of each load is:

$$y = \frac{l^3}{EI}[J_1P_1 + J_2P_2 + J_3P_3]$$

The values of "J" may be obtained from Figure 12, Part 2 of this series.

Example: Given: A steel beam with I = 2135, E = 30,000,000, l in ft. (see Figure 22), g = 386 inches per second per second and y in inches.

$$m = .3 \begin{cases} k & J & P & JP & \frac{l^3}{EI} & y_1 \\ .3 & 25.4 & \times 8000 = 203{,}000 & \times 1.25 \times 10^{-7} & & = .254" \\ .6 & 25.9 & \times 4000 = 103{,}000 & \times 1.25 \times 10^{-7} & & = .130" \\ .8 & 15.03 & \times 6000 = 90{,}200 & \times 1.25 \times 10^{-7} & & = .113" \end{cases}$$

$$\Sigma y_1 = .497"$$

$$m = .6 \begin{cases} k & J & P & JP & \frac{l^3}{EI} & y_2 \\ .3 & 25.9 & \times 8000 = 207{,}000 & \times 1.25 \times 10^{-7} & & = .259" \\ .6 & 33.2 & \times 4000 = 133{,}000 & \times 1.25 \times 10^{-7} & & = .166" \\ .8 & 20.73 & \times 6000 = 124{,}500 & \times 1.25 \times 10^{-7} & & = .156" \end{cases}$$

$$\Sigma y_2 = .581"$$

$$m = .8 \begin{cases} k & J & P & JP & \frac{l^3}{EI} & y_3 \\ .3 & 15.03 & \times 8000 = 120{,}300 & \times 1.25 \times 10^{-7} & & = .151" \\ .6 & 20.73 & \times 4000 = 83{,}000 & \times 1.25 \times 10^{-7} & & = .104" \\ .8 & 14.75 & \times 6000 = 88{,}500 & \times 1.25 \times 10^{-7} & & = .111" \end{cases}$$

$$\Sigma y_3 = .366"$$

For summation of $\frac{\Sigma P_y}{\Sigma P_y^2}$ see Table 9.

Therefore, the frequency of the beam is:

$$fn = \frac{1}{6.28}\sqrt{386 \times 6.9} = 8.22 \text{ cycles per second.}$$

Deflection of Restrained Beams. The deflection of a fixed or restrained beam, reacting under a uniformly distributed load, is obtained by adding algebraically the results of the simple cases shown in Figure 23b and 23c.

Thus, "d", the actual deflection, equals $d_1 - d_2$

or, $d = d_1 - d_2$

$$d_1 = \frac{Fwl^4}{EI}$$

$$d_2 = \frac{G_1M_1l^2}{EI} + \frac{G_2M_2l^2}{EI}$$

$$\text{Then } d = \frac{Fwl^4}{EI} - \left(\frac{G_1M_1l^2}{EI} + \frac{G_2M_2l^2}{EI}\right) \ldots\ldots\ldots \text{Equation 22}$$

Example: For Figure 23b, k = .65, m = .6, then F = 15.2

$$d_1 = \frac{15.2 \times 1000 \times 20^4}{30{,}000{,}000 \times 213.5} = .282 \text{ inches (deflection resulting from the load applied, Figure 23b.)}$$

The deflection resulting from moments M_1 and M_2 being applied are shown in Figure 23c.

For M_1, m = .6 and G_1 = 8.06
For M_2, m = .4 and G_2 = 9.22
Where M_1 = 350,000 inch pounds
and, M_2 = 221,000 inch pounds

$$d_2 = \frac{8.06 \times 350{,}000 \times 20^2}{30{,}000{,}000 \times 213.5} + \frac{9.22 \times 221{,}000 \times 20^2}{30{,}000{,}000 \times 213.5} = .305 \text{ inches}$$

Therefore, d = .382 — .305 = .077 inches

LITERATURE CITED

[1] Freberg and Kemler, Elements of Mechanical Vibration, John Wiley & Sons, Inc., 1943.

ACKNOWLEDGMENT

From a privately circulated book by Charles H. Fork entitled "Structural Design Data on Deflection of Beams" upon which the author holds the copyright.

Easy Method of Stanchion Design

If you are troubled with solving fourth degree equations, here's a way to eliminate that tedious textbook method.

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Philadelphia

STRUCTURAL COLUMNS, resisting horizontal loading, and which depend for stability solely on the embedment of the lower portion in the earth are called Stanchions.

The use of stanchions as an economical means of supporting single pipe lines for industrial installations is being given increased consideration today. The availability of modern soil boring machinery makes the installation comparatively simple to that which is required when single columns are supported on concrete pedestals and footings.

Resistance by some engineers, to the use of stanchions, has been based on what they feel is insufficient knowledge of the action of the soil under such conditions of loading and reluctance to solve fourth degree equations. The first objection regarding soil action is easily overcome when the designer understands that the action is identical with that encountered in the accepted design procedure of sheet piling. The second objection regarding fourth degree equations has been overcome by the use of curves which are the basis for this easy method of stanchion design.

In the following analysis it is assumed that active and passive earth pressures are governed by Coulomb's theory. Expressions for depth of penetration and maximum bending moment can then be derived by the principles of statics.

Figure 1 shows a stanchion subjected to the action of a concentrated wind load "F" acting at a distance "h" above the ground and a vertical load "W" acting at a distance "e" from the center-line of the stanchion.

For stability to be maintained it is required that lateral earth pressures just below ground act in the opposite direction to the overturning force and in same direction farther down.

The movement of the concrete encasement surrounding the stanchion below ground level brings about these pressures; the resulting pressures can therefore be evaluated as the difference between passive and active earth pressures. It is assumed that this passive resistance will be fully mobilized down to a point which is "y" distance from the bottom; and also fully mobilized in the opposite direction at the bottom of the stanchion.

Derivation of Depth of Penetration Required

d = Width of concrete encasement perpendicular to plane of bending. Use ⅔ d when circular.
Pp = Passive earth pressure = $w \tan^2 (45° + \frac{1}{2}\theta)$
Pa = Active earth pressure = $w \tan^2 (45° - \frac{1}{2}\theta)$
Where θ = Angle of repose
w = Weight of earth per cubic foot.

$$\Sigma H = 0$$

$$F - \tfrac{1}{2}(Pp - Pa)dx^2 + (Pp - Pa)dxy = 0$$

$$y = \frac{(Pp - Pa)x^2 - 2F/d}{2(Pp - Pa)x} = \left[\frac{x}{2} - \frac{F}{(Pp - Pa)d} \cdot \frac{1}{x}\right]$$

$$\Sigma M \text{ at bottom} = 0$$

$$F(h + x) + We - \tfrac{1}{6}(Pp - Pa)dx^3 + \tfrac{1}{2}(Pp - Pa)dxy^2 = 0$$

substituting for "y" and reducing:

$$x^4 - \frac{8Fx^2}{(Pp - Pa)d} - \frac{12(Fh + We)x}{(Pp - Pa)d} - 4\left[\frac{F}{(Pp - Pa)d}\right]^2$$

$$\text{Let } B = \frac{F}{(Pp - Pa)d} \text{ and } \frac{M}{F} = h + We/F$$

Then:

$$x^4 - 8Bx^2 - \frac{12M}{F}Bx - 4B^2 = 0$$

This is the equation for the depth of penetration required and may be solved by calculating the parameters "B" and $\frac{"M"}{F}$ and using the curves shown on Figure 2.

Solution for Maximum Moment in Stanchion

Maximum Moment occurs at a point of zero shear a distance "*l*" below surface of ground. Then,

$$\frac{(Pp - Pa)dl^2}{2} - F = 0$$

$$l = \sqrt{\frac{2F}{(Pp - Pa)d}} = \sqrt{2B}$$

$$\text{Maximum Moment} = We + F(h + l) - \frac{(Pp - Pa)dl^3}{6}$$

$$= F\left[\frac{M}{F} + \frac{2\sqrt{2B}}{3}\right]$$

Example

Ten-inch pipe line at 100 pounds per foot including

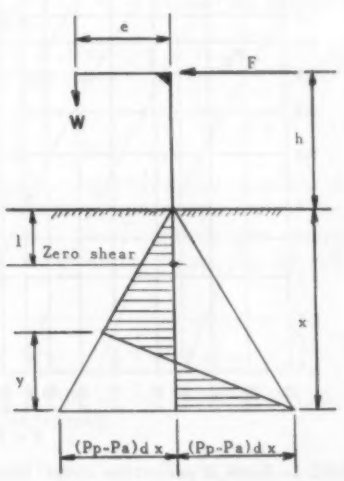

FIGURE 1—Assumed load distribution subjected to wind load "F" and vertical load "W."

Easy Method of Stanchion Design . . .

insulation with stanchions spaced on 25-foot centers. Wind equals 20 pounds per square foot on the projected area (12-inch diameter including insulation).

$w = 100$ pounds per cubic foot
$\theta = 33°$—41 feet for 1 on 1½ slope
$h = 22$ feet, $e = 1$ foot-6 inches
Diameter of concrete encasement "d" = 2 feet
Effective diameter = (⅔) (2.0) = 1.33 feet

Then:

$W = (100)(25) = 2500$ pounds
$F = (1.0)(20)(25) = 500$ pounds
$Pp = (100)(3.49) = 349$ pounds per square foot
$Pa = (100)(0.286) = 29$ pounds per square foot
$(Pp - Pa) = 320$ pounds per square foot

$$\frac{M}{F} = h + We/F = 22.0 + \frac{(2500)(1.5)}{500} = 29.5$$

$$B = \frac{F}{(Pp - Pa)d} = \frac{500}{(320)(1.33)} = 1.2$$

From Figure 2, x = 8-foot depth in soil.

Maximum Moment = F

$$\left[\frac{M}{F} + \frac{2\sqrt{2B}}{3}\right] = 500\left[29.5 + \frac{2\sqrt{2.4}}{3}\right] = 15{,}260 \text{ foot-pounds}$$

Design of stanchion will be in accordance with AISC specification for structural steel.

Try 8-inch WF 24 pound section $\frac{I}{C} = 20.8$ in³

$$\frac{ld}{bt} = \frac{(44)(12)(8)}{(6.5)(0.398)} = 1630$$

$$fb = \frac{12{,}000{,}000}{1630} = 7380 \text{ pounds per square inch}$$

Allowing ⅓ increase in stress for wind.

$$\frac{I}{C} = \frac{M}{S} = \frac{(15{,}260)(12)}{(7380)(4/3)} = 18.7 \text{ in}^3 < 20.8 \text{ in}^3, \text{ there it's O.K.}$$

Stresses in column and soil at bottom of stanchion due to direct load is usually so small as compared to the bending stresses that they normally may be neglected.

##

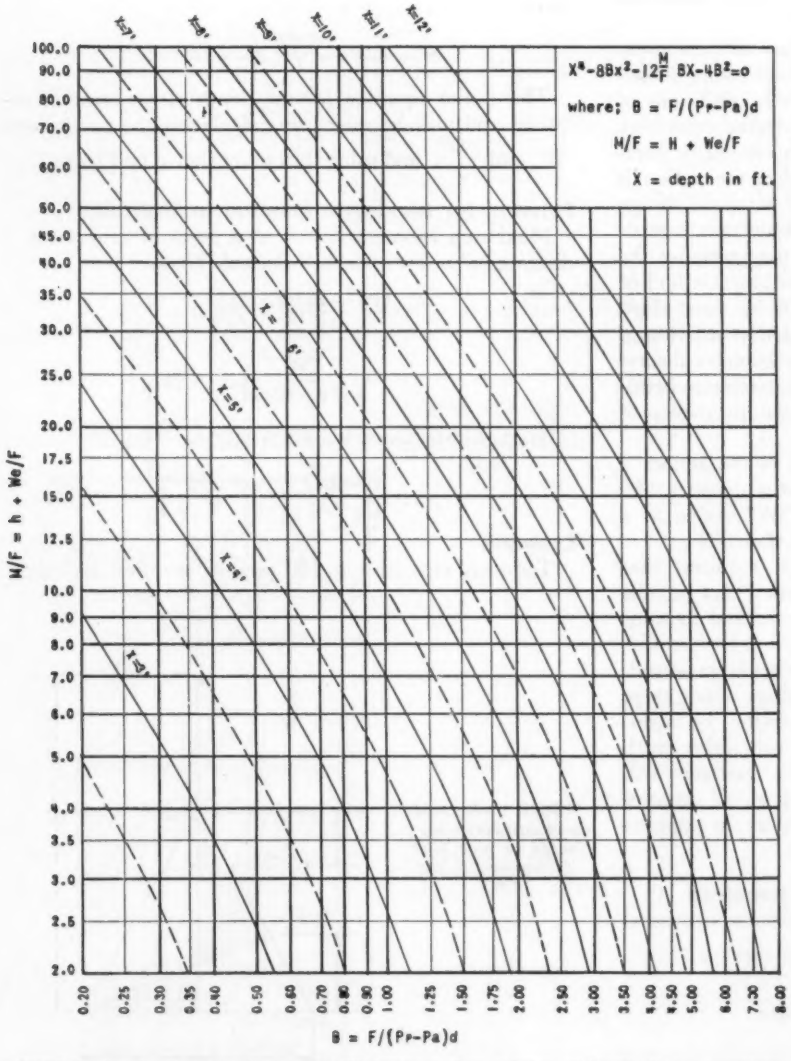

FIGURE 2—Depth of penetration curves. Eliminates tedious solution of fourth degree equations.

TABLE 1

Slope Ratio	Angle θ	TAN² (45° + ½θ)	TAN² (45° − ½θ)
1 on 5	11° 19′	1.488	0.672
1 on 4	14° 2′	1.640	0.610
1 on 3	18° 26′	1.925	0.520
1 on 2	26° 34′	2.618	0.382
1 on 1½	33° 41′	3.490	0.286
1 on 1⅓	36° 52′	4.000	0.250
1 on 1	45° 0′	5.828	0.172
1½ on 1	56° 19′	10.913	0.092
2 on 1	63° 26′	17.942	0.056
3 on 1	71° 34′	37.980	0.026
4 on 1	75° 58′	66.012	0.015
5 on 1	78° 41′	101.869	0.010

About the Author

W. B. SUMMER graduated from Drexel Institute of Technology with a B.S. degree in civil engineering in 1941. He began his career as an assistant civil engineer with the Tennessee Valley Authority, but within a year, the war timetable was put into effect, and Summer became a naval architect in the U. S. Navy's Bureau of Ships. By 1946, Summer was back in Drexel as an instructor. His stay at Drexel was short, and following interludes as a structural engineer and designer, he joined Catalytic Construction Company in 1947 as senior structural engineer, a post he holds today.

Do your own calculations on . . .

Steam-Flash Vaporization Of Multicomponent Mixtures

These equations represent a terrific advance in the theory of steam-flash vaporization. Even though they are for multicomponent mixtures, the equations are easily applied.

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MANY HIGH BOILING organic compounds may be partially separated from non-volatile components by the use of steam in a flash vaporization process. The use of steam permits the distillation to be carried out at relatively low temperatures and at convenient operating pressures. Equations describing two general cases are stated here. In the first case, the partial vaporization of a multicomponent mixture of volatile components plus any number of non-volatile components in the presence of steam is considered. The non-volatile components are taken to be soluble in the volatile components. An equation is shown by which the vapor formed from the volatile components and the corresponding liquid may be calculated for any steam rate up to and including rates beyond those at which condensation occurs. This equation may be solved by use of Newton's method.[1] This method lends itself readily to the statement for a computer program.

In addition, the case is treated where the non-volatile components do not alter the mole fractions of the volatile components. The equations give the steam requirement for complete vaporization of the volatile components. The treatment given is for multicomponent mixtures. For the special case of two volatile components, Robinson and Gilliland[2] have stated equations.

Development of Equations

1. Non-Volatile Components Soluble in Volatile Components

When the feed mixture contains inert gases (gas phase components only) and where there is no probability of condensation, the equations stated previously[1] are applicable. When steam is employed, the equations stated previously are not as convenient as those shown below. In the development, use is made of the fact that the ratio of the partial pressure of steam to the total pressure is equal to the ratio of the moles of steam employed to the total moles of vapor leaving the flash chamber. That is

$$\frac{p_s}{\pi} = \frac{S}{V+S} \qquad (1)$$

Solving for S/V

$$S/V = \frac{p_s/\pi}{1-p_s/\pi} = a \qquad (2)$$

The maximum rate, S, which can be employed without condensation occurs when $p_s = P_s$, the vapor pressure of steam at the temperature of the flash. The total pressure, of course, must be set at a value greater than P_s. All symbols employed are defined in the Notation. In solving the flash problem, it is convenient to set p_s, π, and the temperature of the flash. The latter must, of course, be greater than the boiling point temperature corresponding to the specified p_s and π. Having set p_s and π, "a" is calculated by equation (2). Then S can be expressed in terms of V, namely S = aV. In the two phase region, the same over-all material balance applies as was stated previously.[1]

$$F_t X_{fi} = Lx_i + V_t y_i \qquad (3)$$

For every component except steam $X_{fi} = Fx_{fi}/F_t$, and for steam $X_f = \frac{S}{F_t}$. Then where "i" does not equal to steam, $i \neq s$, equation (3) may be written.

$$Fx_{fi} = Lx_i + V_t y_i, \; i \neq s \qquad (4)$$

In the derivation, x and y are for convenience related by use of Raoult's law. When Henry's law is applicable, the final equations may be restated in terms of it. Placing $y_i = P_i x_i/\pi$ and solving equation (4) for y_i, one obtains,

$$y_i = \frac{Fx_{fi}}{V_T + (L\pi/P_i)} \qquad (5)$$

The total vapor flow, $V_t = V + S$ may be stated in terms of L and F as follows

$$V_t = V + S = V + aV = (1+a)(F-L) \qquad (6)$$

Then equation (5) can be written

$$y_i = \frac{x_{fi}}{(1+a) - \frac{L}{F}\left[(1+a) - \frac{\pi}{P_i}\right]}; \; i \neq s \qquad (7)$$

In addition to the volatile components, this equation also holds for all the non-volatile components, since for these $P_i = 0$, which gives $y_i = 0$. Summing both sides of equation (7) over all components except steam, the following expression is obtained:

$$1 - y_s = \sum_{i \neq s} \frac{x_{fi}}{(1+a) - \frac{L}{F}\left[(1+a) - \frac{\pi}{P_i}\right]} \qquad (8)$$

The mole fraction of steam in the vapor phase, y_s, is stated in terms of "a" as follows:

$$y_s = \frac{S}{S+V} = \frac{aV}{V+aV} = \frac{a}{1+a} \qquad (9)$$

Steam-Flash Vaporization . . .

Adding y_s to both sides of equation (9) gives,

$$1 = \sum_{i \neq s} \frac{x_{fi}}{(1+a) - \frac{L}{F}\left[(1+a) - \frac{\pi}{P_i}\right]} + \frac{a}{1+a} \quad (10)$$

For convenience, let $\Theta = L/F$ and let the function $f(\Theta)$ be defined by:

$$f(\Theta) = \sum_{i \neq s} \frac{x_{fi}}{(1+a) - \Theta\left[(1+a) - \frac{\pi}{P_i}\right]} - \left(\frac{1}{1+a}\right) \quad (11)$$

The last term on the right-hand side results from the combination of $[a/(1+a)] - 1 = -1/(1+a)$. This equation may be solved for the desired root, $\Theta = \Theta_r$ by Newton's method. When $\Theta_r = L/F$ is determined, the corresponding values of V, L, and S = aV are readily calculated. The first derivative of $f(\Theta)$, needed for application of Newton's method, is:

$$f'(\Theta) = \sum_{i \neq s} \frac{x_{fi}\left[(1+a) - \pi/P_i\right]}{\left[(1+a) - \Theta\left([1+a] - \frac{\pi}{P_i}\right)\right]^2} \quad (12)$$

Newton's method, shown previously,[1] consists of the repeated use of

$$\Theta_r = \Theta_a - \frac{f(\Theta_a)}{f'(\Theta_a)} \quad (13)$$

until the desired accuracy of the root Θ_r is obtained. It can be shown in the same manner as that described previously,[1] that Newton's method always converges to the desired root $\Theta = \Theta_r$, when the initial value assumed for Θ is $\Theta_a = 1.0$.

As stated previously, equation (11) is also applicable when condensation of a part of the steam occurs, provided the condensate is immiscible in the liquid L. The symbol S appearing in the equations refers to the steam which passes through the system in the vapor phase. The value of "a" corresponding to this S is given by $(P_s/\pi)/(1 - P_s/\pi)$. Any steam fed to the system in addition to that calculated from equation (12) on the basis of the above "a" would be condensed.

2. Complete Vaporization of the Volatile Components

(Where it is assumed that the non-volatile components do not alter the mole fractions of the volatile components)

This case has been treated for a binary system of volatile components by Robinson and Gilliland.[2] The present treatment is applicable to a steam flash distillation of a multicomponent mixture of a volatile and non-volatile components. The equations lead to the steam requirement.

Since all of the volatile components of the feed are completely vaporized, the following relationship holds for the vapor space of the flash chamber.

$$\frac{p_s}{\pi - p_s} = \frac{S}{L_t^\circ} \quad ; \text{ or } \frac{\pi - \sum_{i \neq s,r} p_i}{\sum_{i \neq s,r} P_i x_i} = \frac{S}{L_t^\circ} \quad (14)$$

Since the non-volatile components in no way affect the distillation, they are not included. The object of the derivation which follows is to express the partial pressures in terms of the moles of the various components in the feed. Since the vapor is taken to be at its dew point,

$$\sum_{i \neq s,r} p_i = \sum_{i \neq s,r} P_i x_i \quad (15)$$

It is readily shown that for all components except steam and of course, the non-volatile components are excluded, that

$$x_i = \frac{y_i/\alpha_i}{\sum_{i \neq s,r} y_i/\alpha_i} \quad (16)$$

Where α_i is used here to denote P_i/P_b, where P_b is the vapor pressure of the base component at the flash temperature. The total moles of vapor is $(L_t^\circ + S)$ and $(L_t^\circ + S)y_i = L_i^\circ$, moles of any volatile component in the feed (L_i° is also equal to the moles of this compo-

TABLE I—Solution of Example 1

$F = 100$ moles
$\pi = 200$ mm. Hg
$a = 19$

COMPONENT	x_f	P_i	P_i/π	First Trial, $\Theta_a = 1.0000$: $\frac{x_{fi}}{(1+a) - \Theta\left[(1+a) - \frac{\pi}{P_i}\right]}$	First Trial, $\Theta_a = 1.0000$: $\frac{x_{fi}(1+a-\frac{\pi}{P_i})}{\left[(1+a) - \Theta\left((1+a) - \frac{\pi}{P_i}\right)\right]^2}$
A	0.30	20	0.10	0.0300	0.0300
B	0.25	14	0.07	0.0175	0.0070
C	0.25	8	0.04	0.0100	−0.0020
D	0.20	0	0.00	0.0000	0.0000
				$\frac{1}{1+a} = -0.05$	$f'(\Theta_a) = 0.0350$
				$f(\Theta_a) = 0.0075$	

$$\Theta_r = 1.000 - \frac{0.0075}{0.0350} = 0.7858$$

Second Trial: $\Theta_a = 0.7858$
Results: $f(\Theta_a) = 0.00125$; $f'(\Theta_a) = 0.02409$

$$\Theta_r = 0.7858 - \frac{0.00125}{0.02409} = 0.7340$$

Third Trial: $\Theta_a = 0.7340$
Results: $f(\Theta_a) = 0.00006$; $f'(\Theta_a) = 0.02248$

$$\Theta_r = 0.7340 - \frac{0.00006}{.02248} = 0.7314$$

From the results of the third trial we see that Θ_r is very nearly equal to Θ_a so we may take L/F equal to 0.7314.

Since F = 100 moles, then L = 73.14 moles
The moles of acid in the vapor = 100 − 73.14 = 26.86 moles
The moles of steam required are calculated as follows:
S = aV = (19) (26.86) = 510.34 moles
Then the total moles of feed are:
$F_t = 100 + 510.34 = 610.34$ moles

nent leaving the flash chamber). In view of this relationship, equation (16) may be written:

$$x_i = \frac{L_t^\circ/\alpha_i}{\sum_{i \neq s, r} L_t^\circ/\alpha_i} \qquad (17)$$

Upon substitution of this expression for x_i in equation (15), it is seen that,

$$\sum_{i \neq s, r} p_i = \frac{\sum_{i \neq s, r} P_t L_t^\circ/\alpha_i}{\sum_{i \neq s, r} L_t^\circ/\alpha_i} = \frac{P_b \sum_{i \neq s, r} L_t^\circ}{\sum_{i \neq s, r} L_t^\circ/\alpha_i}$$

which reduces to

$$\sum_{i \neq s, r} p_i = \frac{P_b L_t^\circ}{\sum_{i \neq s, r} L_t^\circ/\alpha_i} = \frac{L_t^\circ}{\sum_{i \neq s, r} L_t^\circ/P_i} \qquad (18)$$

When this expression for the sum of the partial pressures is substituted in equation (14), the final equation giving the steam requirement in terms of known quantities is obtained, namely:

$$\frac{S}{L_t^\circ} = \left[\left(\frac{\pi}{L_t^\circ}\right) \sum_{i \neq s, r} \frac{L_t^\circ}{P_i}\right] - 1$$

Or

$$\frac{S}{L_t^\circ} = \left[\left(\frac{\pi}{P_b L_t^\circ}\right) \sum_{i \neq s, r} L_t^\circ/\alpha_i\right] - 1 \qquad (19)$$

For the case of two volatile components, equation (19) reduces to:

$$\frac{S}{L_t^\circ} = \left(\frac{\pi}{L_t^\circ}\right)\left(\frac{L_1^\circ}{P_1} + \frac{L_2^\circ}{P_2}\right) - 1$$

This equation may be rearranged to the same form as the one stated by Robinson and Gilliland.[2]

When the heat necessary to effect the vaporization at the specific flash temperature is supplied by the steam, condensation of steam is likely. Taking the condensate to be immiscible in the liquid phase, the equations describing this system are derived in a manner similar to that shown above. These equations are as follows:

$$S = P_s \sum_{i \neq s, r} L_t^\circ/P_i \qquad (20)$$

and

$$\frac{\pi}{P_s} = \frac{L_t^\circ + S}{S} \qquad (21)$$

where, S represents only the moles of steam leaving the system in the vapor state. When the temperature of the flash is specified, the moles of steam leaving with the vaporized volatile components may be calculated immediately by equation (20). The total pressure of the flash may then be calculated by use of equation (21). The moles of steam condensed is then calculated by an overall heat balance.

Illustrative Example 1—It is desired to separate three high boiling organic acids from a soluble non-volatile material by steam-flash distillation. The initial mixture contains 80 moles of the acids and 20 moles of the non-volatile material. The organic acid mixture contains 30 moles of the low boiler and 25 moles of the other two. The flash distillation is to be carried out at 100 C and at a total presure of 200 mm. of mercury. The vapor pressures of the acids are 20, 14, and 8 mm. of mercury at 100 C. Calculate the moles of liquid, L, the moles of vapor, V, and the moles of steam required if the vapor leaving the flash still is to be 95 mole percent steam.

Illustrative Example 2—For the case where the non-volatile components do not alter the mole fractions of the liquid in equilibrium with the total vapor leaving the still, calculate the moles of steam required to vaporize all of the organic acids of Example 1. The temperature and pressure are the same as those stated in Example 1.

The solutions of these examples are shown in Tables 1 and 2.

ACKNOWLEDGMENT

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[1] Holland, C. D., and Davison, R. R., PETROLEUM REFINER, 36, No. 3, 183 (March, 1957).
[2] Robinson, C. S., and Gilliland, R. E., "Elements of Fractional Distillation," Fourth Edition, McGraw-Hill Book Company, Inc., New York, Toronto and London, 111-114 (1950).

TABLE II
Solution of Example 2

This problem is solved by use of equation (19).
Basis: L_t° = 80 moles
π = 200 mm. Hg

COMPONENT	L_i°	P_i	L_i°/P_i	$\frac{\pi}{L_t^\circ}(L_i^\circ/P_i)$
A	30.0	20	1.500	3.750
B	25.0	14	1.785	4.462
C	25.0	8	3.125	7.812
				16.024

$$\frac{S}{L_t^\circ} = \left[\frac{\pi}{L_t^\circ} \sum \left(\frac{L_i^\circ}{P_i}\right)\right] - 1$$

$$\frac{S}{L_t^\circ} = 16.024 - 1 = 15.026 \text{ moles of steam per 80 moles of volatile components.}$$

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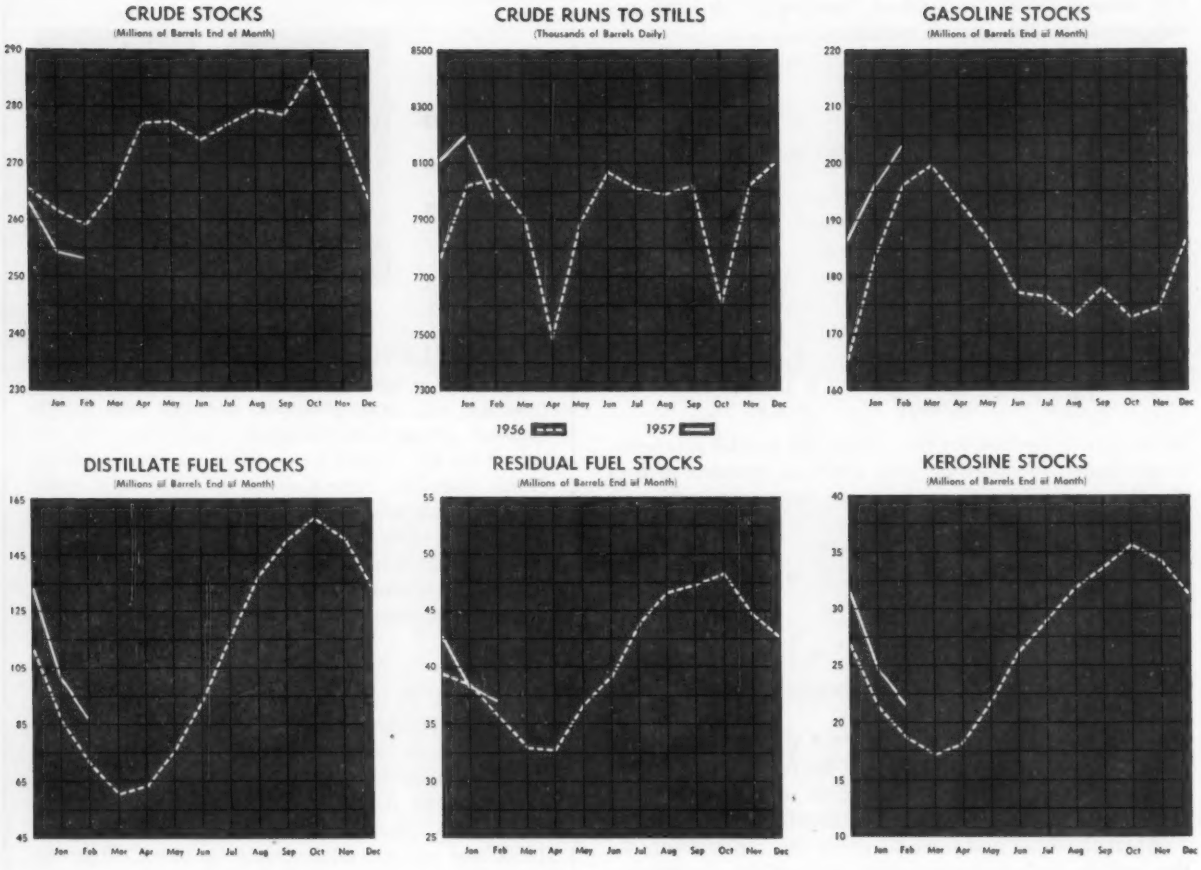


Taking Stock

Cecil W. Smith
Economics Editor

- **Refineries making seasonal cuts**
- **Gasoline stocks at all-time peak**
- **Fuel oil supplies still dropping**

MONTH	CRUDE OIL			GASOLINE		KEROSINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1955:													
February	6,835	7,549	258,630	3,655	181,643	374	18,291	1,847	68,513	1,239	46,042	751	1,379
March	6,886	7,374	264,430	3,543	183,972	357	18,187	1,703	62,457	1,185	44,970	742	1,319
April	6,887	7,136	275,232	3,502	175,601	312	21,486	1,534	70,139	1,110	43,838	697	1,123
May	6,677	7,281	276,948	3,605	168,751	296	26,375	1,519	83,559	1,111	45,083	742	1,137
June	6,613	7,484	270,850	3,725	157,439	269	29,830	1,628	100,652	1,080	44,398	764	1,159
July	6,632	7,580	264,601	3,824	157,079	286	32,749	1,575	119,169	1,091	44,894	860	1,161
August	6,665	7,580	256,427	3,858	151,912	290	35,292	1,621	133,675	1,090	45,480	756	1,155
September	6,731	7,483	256,269	3,784	150,194	279	36,361	1,621	143,248	1,061	46,267	829	1,218
October	6,837	7,465	267,346	3,827	153,103	309	36,705	1,612	152,288	1,123	47,040	821	1,206
November	7,014	7,692	260,707	3,867	157,871	341	33,283	1,680	141,808	1,214	44,071	823	1,322
December	7,155	7,762	265,610	3,916	165,433	395	26,770	1,765	111,333	1,286	39,174	884	1,502
1956:													
January	7,199	8,023	261,592	3,927	183,905	385	21,310	1,923	86,141	1,344	38,247	805	1,422
February	7,208	8,047	259,504	3,854	196,092	385	18,712	1,918	71,335	1,286	35,673	878	1,472
March	7,278	7,914	265,683	3,829	199,698	342	17,215	1,808	60,846	1,213	32,984	934	1,425
April	7,146	7,487	277,121	3,646	193,299	299	18,227	1,713	63,571	1,130	32,740	815	1,305
May	7,064	7,896	277,497	3,859	186,673	292	21,883	1,667	75,928	1,149	36,607	938	1,416
June	7,100	8,071	274,491	3,976	177,076	290	26,111	1,755	93,758	1,098	39,073	987	1,426
July	7,090	8,014	277,008	3,975	176,536	296	28,990	1,767	115,787	1,066	43,958	1,084	1,463
August	7,195	7,995	279,944	4,037	172,939	313	31,826	1,839	137,905	1,091	46,617	1,001	1,399
September	7,054	8,024	278,791	3,991	177,974	329	33,588	1,845	150,411	1,062	47,342	1,043	1,452
October	6,966	7,608	286,560	3,773	172,798	356	35,667	1,772	158,871	1,082	48,400	1,004	1,541
November	7,139	8,031	275,995	3,913	174,808	384	34,329	1,841	151,517	1,182	44,590	871	1,362
December	7,377	8,141	266,014	4,039	187,271	379	31,420	1,981	133,981	1,288	44,491	873	1,471
1957:													
January	7,412	8,205	254,048	3,900	196,351	376	24,622	2,077	100,369	1,270	38,212	796	1,317
February	7,516	7,992	253,093	3,789	203,749	359	21,469	2,029	85,698	1,243	37,068	802	1,389
Week Ended:													
3-22-57	7,818	7,976	254,102	3,580	205,521	324	19,978	1,836	77,603	1,198	36,886	697	1,256
3-23-56	7,163	7,970	260,037	3,684	196,801	362	17,710	1,760	65,912	1,233	34,047	957	1,361

Source: Data for last two months from API; prior monthly data from Bureau of Mines. Data in thousands of barrels.

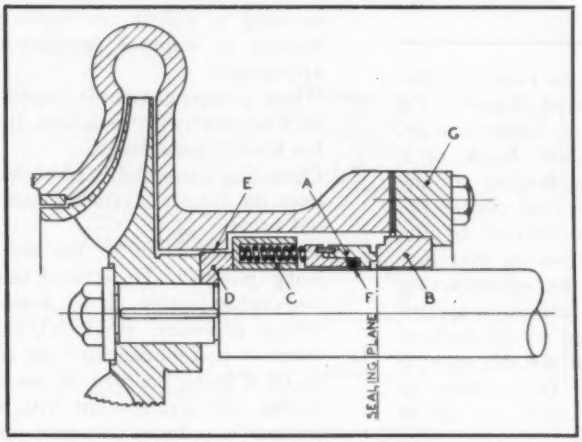


FIGURE 1—Basic elements of a mechanical seal.

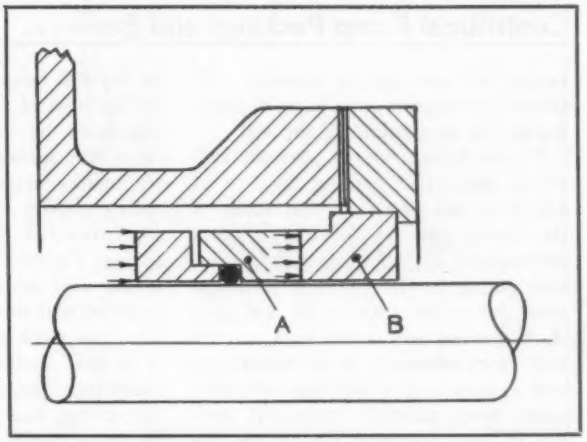


FIGURE 2—The stuffing box pressure is transmitted through rotating element *A* to stationary element *B*.

Centrifugal Pump Packings and Seals

Handbook

Part 1 – Packing Boxes and Glands
Part 2 – Packings
Part 3 – Mechanical Seals
Part 4 – Mechanical Seal Maintenance
Part 5 – Packing Maintenance

Here's a complete discussion on mechanical seal application so that you will know which type to use and where.

Harold Woodhouse
Dean Hill Pump Company
Indianapolis

THE MECHANICAL SEAL may be described as a precision machined mechanical device used as an alternative to soft shaft packing in centrifugal pumps. The mechanical seal did not burst on the pump world as a fully developed, single idea invention. It has evolved slowly after being born out of the necessity for improving the sealing afforded by conventional packing on difficult applications.

The basic elements of a mechanical seal are shown as in Figure 1. The sealing plane occurs where the rotary sealing element *A* contacts stationary sealing element *B*. Contact of the sealing faces is maintained by Spring *C* which is held in the correct state of compression by distance piece *D* made to the proper length. Sometimes, to limit the flow in the event of complete failure of the seal, a restricted running clearance is provided ahead of the seal as at *E*. To prevent leakage along the shaft a ring of soft material, such as neoprene, is compressed at *F*. The stationary sealing face *B* is usually held in gland plate *G*.

All mechanical seal designs are variants of this arrangement. They may be described as single or double —Figure 1 is a single seal; a double seal is essentially two single seals mounted back to back—and balanced or unbalanced, which needs some explanation as follows:

In Figure 2 the entire hydraulic thrust resulting from the pressure existing in the stuffing box acting on the back of the rotating seal element *A* is transmitted across the sealing face to stationary element *B*. Because of the high thrust loading resulting from this entirely unbalanced force, this type of seal is restricted to conditions where a low stuffing box pressure exists. The actual value of the low pressure might be anything from a

pound or two up to, possibly, 120 pounds per square inch gage, depending on the dimensions of the seal.

Figure 3 illustrates a partially balanced seal. The contact face of *A* has been cut down so that some of the thrust load on the rear of *A* is neutralized by the stuffing box pressure acting in the opposite direction over the outer annulus of seal ring *A*. With the net thrust load on the seal faces reduced, it is possible to seal against higher stuffing box pressures. Such partially balanced seals are in very common use where the stuffing box pressures reach approximately 200 psig. It may seem repetitious to keep writing "stuffing box pressure" but it is important in specifying mechanical seals that only the pressure likely to be existing in the stuffing box be considered and not the discharge pressure. If, for instance, one specified seal pressure as the discharge pressure, one might be quoted a considerably more expensive seal to take care of a pressure which is never going to exist at the seal.

Figure 4 illustrates a fully balanced seal. By stepping down the shaft (or sleeve, if the seal is mounted on a shaft sleeve) the counterbalancing thrust force acting on the outer annulus of rotary seal ring *A* may be made as large as the thrust force on the rear of *A*. Such a balanced seal can be used for high pressure in the range of 1000 psig. In practice, seals are purposely not completely balanced. A 10 to 15 percent out-of-balance is preferred. The reason for this is that it is desirable to have a certain amount of out-of-balance pressure at all times to maintain contact of the seal faces in the event that the spring load of *C* on *A* (Figure 1) is decreased by loss of spring temper, or if the spring should break, or if the spacer or collar backing up the spring should move and release the compressive force exerted by the spring. Figure 5 shows an over balanced seal where the counteracting force on seal ring *A* annulus is greater than the force acting on the back of *A* so that contact of the seal faces is maintained only by the pressure of the spring. Such a seal would not be made for pump use.

The most important factor in the design of a mechanical seal is the choice of materials for the rotating and stationary seals. In most refinery services the rotating seal is carbon and the stationary one stellite. For water, carbon and bronze is common. Many other materials, such as ceramics are used with carbon for sealing against corrosive fluids.

Where Seals Should Be Used. Having described and illustrated the basic principles of mechanical seals one might proceed to inquire why and where should they be used:

1. Every maintenance man knows, or soon finds out, that a certain amount of liquid leakage must be allowed past the packing rings in a conventionally packed stuffing box; with mechanical seals the leakage is almost non-existent. This is advantageous because:
   a. Liquid leakage loss is a consideration where expensive liquids are being pumped.
   b. The pumping unit is cleaner so that a drip rim baseplate is not essential to collect packing box leakage to improve installation appearance.
   c. When pumping volatile liquids, such as refinery hydrocarbons, the fire hazard is minimized.
   d. Operating personnel is protected from the danger of inhaling noxious fumes.
   e. Non-contamination of the fluid being pumped. To achieve this non-contamination, it is sometimes necessary, particularly where a non-lubricating type of liquid is being handled, to use a double seal arrangement with a coolant introduced between the two seals as shown in Figure 6.
2. There is no rubbing friction on the shaft or shaft sleeves and this eliminates expensive rotor parts replacements. In this connection, one might add, when clear and non-corrosive liquids are being pumped, it is desirable to eliminate the use of shaft sleeves and mount the seals directly on the shaft. This removes the possibility of a liquid leakage short circuiting the mechanical seal by leaking along the shaft inside the sleeve bore.

   When conversion of an old pump having shaft sleeves is made from soft packing to mechanical seals it is often necessary to remove the shaft sleeves to provide room for the seals between the shaft diameter and the available packing box bore. This can also mean a replacement shaft is required with threads for impeller lock nuts at different locations.
3. A pump designed for mechanical seals alone can be made more compact thereby reducing the overall size, axial length and weight of the

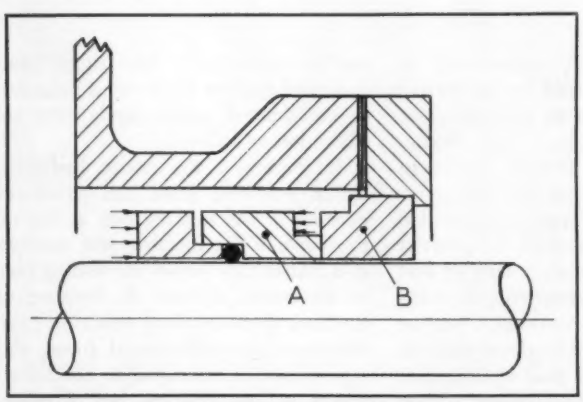


FIGURE 3—Partially balanced seal allows some of the thrust load to be applied to a cut face on the rotating element A.

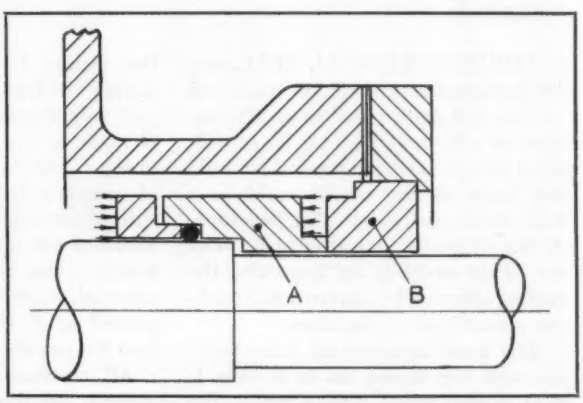


FIGURE 4—Fully balanced seal has counter-balancing thrust force acting on the outer annulus of A which is as large as the thrust force on the rear of A.

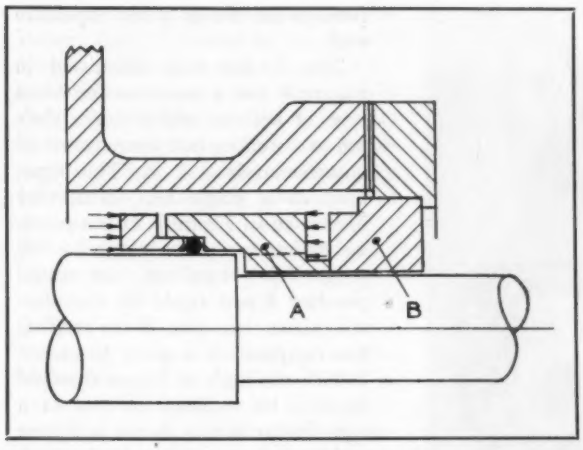


FIGURE 5—Over-balanced seal has counter-balancing force greater than the thrust force.

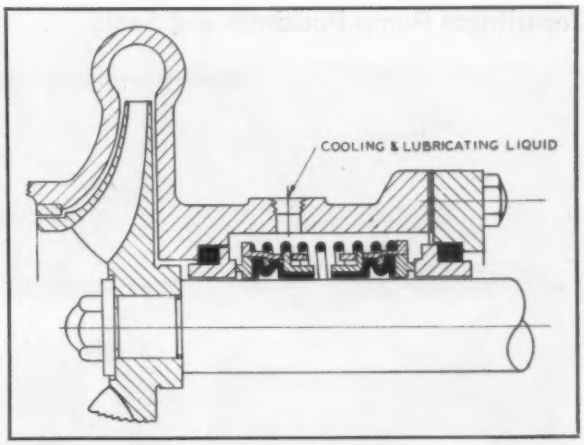


FIGURE 6—Double mechanical seals permit the handling of gritty liquids.

pump and conserving floor space. The shorter shaft becomes more rigid so the pump should be less susceptible to vibration troubles resulting from shaft deflections. It should be noted, however, that a great many pumps, although fitted with mechanical seals, are made so that, with the seals removed, standard soft packing may be used. The thinking at the back of this, as far as the operators are concerned is, probably, a certain amount of doubt about the reliability of mechanical seals for the particular application in mind; or the thought that should the mechanical seals break down, soft packing can immediately be installed whereas it might take weeks to get a replacement mechanical seal if none are carried in stock.

4. The area of rubbing surface of the seal is quite small. There is, therefore, less friction and this means a saving of power and an increase in pump efficiency.
5. The sealing surfaces are precision ground to an unusually high degree of smoothness. So no break-in runs are required with mechanical seals as with soft packing where the pump must run for a time with a more than usual leakage to permit the packing to seat and adjust itself to the shaft.
6. Burning and/or scoring of shaft or sleeves from too much or unequal tightening of packing gland bolts is eliminated.
7. The small contact area and negligible friction loss of mechanical seals makes them advantageous for high pressures and speeds. Already, at such moderate stuffing box pressures as 50 psig., considerable troubles are experienced with soft packing and considerable experimentation may be necessary to find the grade of packing which will perform satisfactorily in a given application.

Because of the relatively high pressure exerted by soft packing on shafts or sleeves (a pressure which must be increased as the stuffing box liquid pressure increases) it becomes more difficult to maintain a seal as the shaft rubbing speed or stuffing box pressure increases. The liquid film, essential to packing lubrication, is more difficult to maintain. Under high pressure a soft packing may be extruded from the stuffing box.

8. Because the rotating seal element of a mechanical seal is flexibly mounted and maintained in contact with the stationary element by spring pressure, it can adjust itself automatically to shaft whip, axial end play and seal face wear.
9. Double mechanical seals permit the handling of gritty liquids, high vacuums and applications where there is inadequate lubrication. Such an arrangement is shown by Figure 6. It consists of two bellows type mechanical seals placed back to back in a stuffing box. Leakage from the impeller space into the

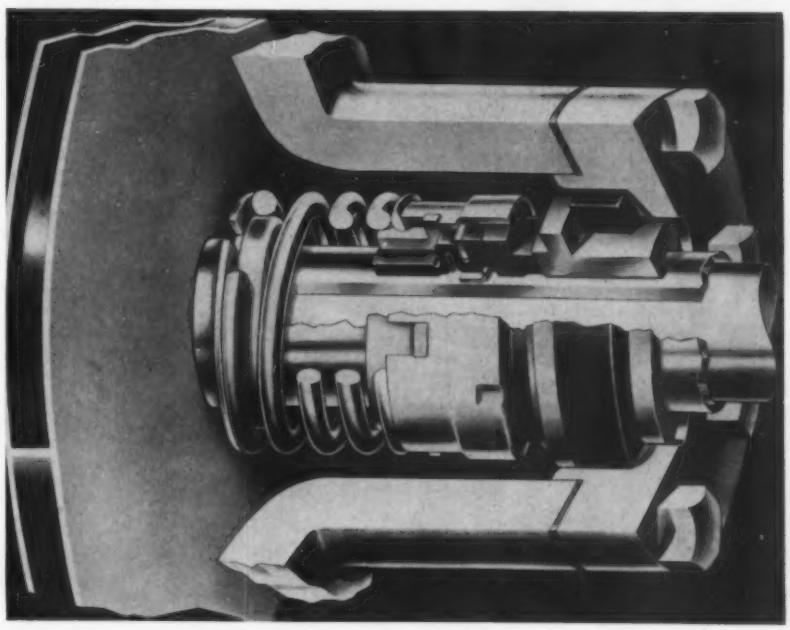


FIGURE 7—Double mechanical seals have a neoprene or buna type bellows.

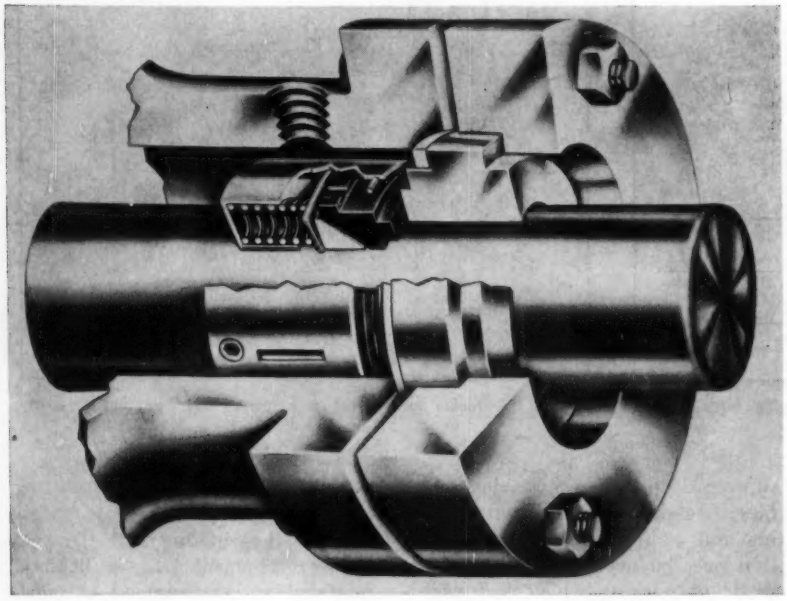


FIGURE 8—For temperatures greater than 212 F, the neoprene or buna bellows is replaced by a teflon wedge ring.

stuffing box is prevented by the mechanical seal on the left and leakage from the packing box to atmosphere is prevented by the mechanical seal on the right. Into the space between and surrounding these two seals is fed, at a pressure higher than the pumped liquid, a clear, lubricating liquid. The term lubricating does not necessarily refer to oil. It can be, and frequently is, water. In many instances this lubricating liquid performs the additional important function of cooling the seals below the temperature of the pumped liquid and thereby permits the use of a less expensive seal.

The double seals illustrated in Figure 6 use a neoprene or buna type of bellows which limits their use to a stuffing box temperature of approximately 212 F. This type, used as a single seal, is further illustrated in Figure 7. It is a popular design for pressures up to 200 psig. With cooling, the actual pumped liquid could be considerably more than this. If the stuffing box temperature is going to exceed 212 F., the seals of Figure 6 would have to be replaced by two of a type similar to that shown in Figure 8 where the neoprene or buna is replaced by a teflon wedge ring which is recommended for a stuffing box temperature up to 490 F.

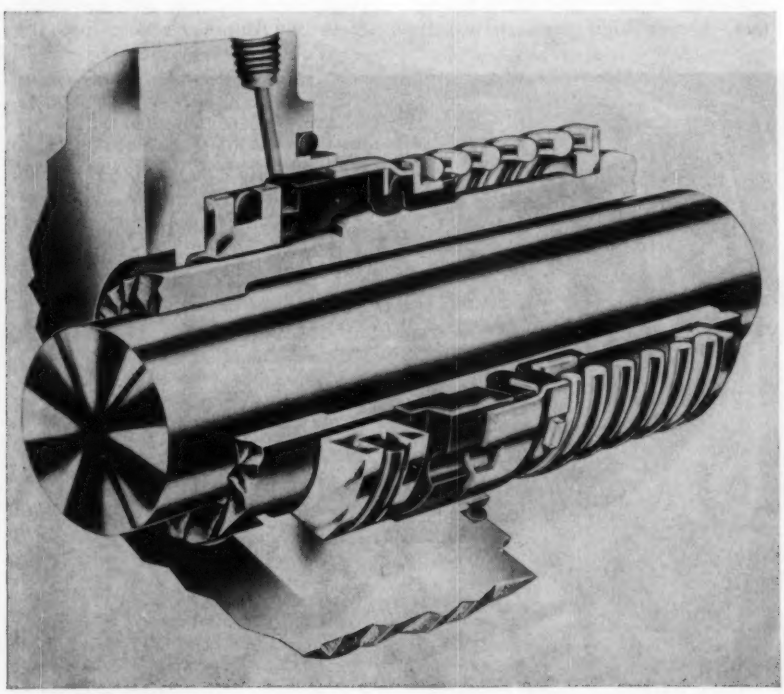


FIGURE 9—For pressures greater than 200 psig, a modified balanced seal is used.

Seals for High Pressure. If the stuffing box temperature remains moderate but the pressure is increased beyond 200 psig., a modified balanced version may be used as shown by Figure 9. Its use does necessitate a stepped shaft or sleeve but it can be used up to 550 psig. The step is necessary to permit lowering the seal face diameters for a greater balancing of forces. This design is widely used in the petroleum processing industry for high pressure, light hydrocarbon service.

When the pressure exceeds 550 psig. but is under 1200 psig. and the temperature is under 250 F., the bellows construction of Figure 9 is not used; instead, a seal as shown by Figure 10 is used where the neoprene or buna bellows of Figure 9 is replaced by "O" rings. With this particular design the whole assembly is mounted on a sleeve which is secured to and by a collar on the shaft. The rotating elements of the seal are driven from the sleeve by keys.

It should be noted that it is the general practice of seal manufacturers to recommend the use of balanced mechanical seals on all light hydrocarbon applications, regardless of pressure, because of their volatile, easy flashing characteristics. Balanced seals are also recommended for high temperature oil, toxic liquids such as acid treated oils, phenol solutions and other chemicals.

Figure 10 shows a seal with the locking collar externally mounted, i.e. on the outside of the gland plate, where it is visible and accessible at all times. It could be conveniently de-

signed to be at the other end of the sleeve; then, it would be an entirely internally mounted seal.

Sometimes, because of an unavailability of packing box space (usually in instances of conversion from packing to mechanical seals) the seal may be entirely externally mounted as shown by Figure 11. This arrangement is generally recommended only by necessity and for low speeds.

Figure 10 also shows a seal which is fitted with auxiliary packing. This arrangement is used where no inflammable, noxious or explosive fumes or vapors whatever can be allowed to escape to the surrounding atmosphere and is referred to as a smothering chamber or gland. This type is also used with liquids subject to crystallization or solidification.

A pipe connection is shown to which a water supply may be connected for flushing away the leakage which has penetrated past the seal faces. Instead of the auxiliary packing a close fitting metallic bushing is often used.

The auxiliary packing or bushing perform the dual functions of restricting, smothering or flushing liquid leakage and, in the event of complete failure of the mechanical seal, limit the leakage of dangerous vapors to atmosphere.

Care of Seals. The effectiveness of mechanical seals is entirely dependent on the fineness of finish of the seal faces which are lapped flat with extreme precision to a fine, smooth surface having a variation of only 23.2 millionths of an inch, or two light bands.

This extreme smoothness reduces the rubbing friction of the spring loaded rotating seal against the stationary seal face to the point where, with a minimum of lubrication, the seal can operate up to 5000 feet per minute rubbing speed. For the normal operating speed of 3500 revolutions per minute for a centrifugal pump, the limiting maximum seal face diameter is, then, $5\frac{15}{32}$ inches.

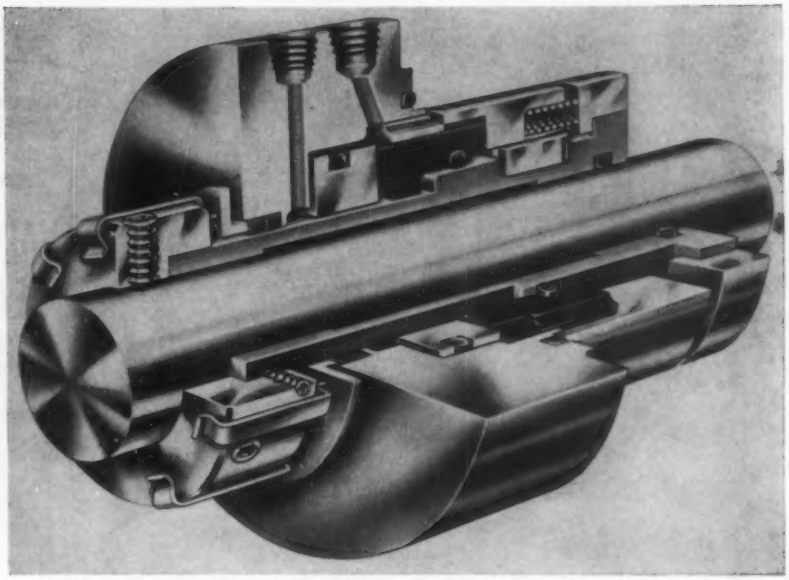


FIGURE 10—For pressures greater than 550 psig, bellows are replaced by "O" rings and a locking collar is externally mounted.

One must not overlook the fact in connection with mechanical seals, that, although they are an excellent and useful design, they can be a disappointment if improperly applied and handled.

The one all-important condition over which the seal manufacturer has no control, other than in the printed recommendations accompanying a new seal, is the care of handling seals in the field by customer's maintenance personnel. Details of this will be described in a later installment under the heading of Installation and Maintenance of Mechanical Seals.

As previously mentioned, the seal faces are products of extreme precision. Now, the vast majority of commercial mechanical seals have rotating seal faces made of carbon, of the remainder most will not have dead hard faces. The result is that it is very easy, due to careless handling and an unawareness of the vulnerability of the seal face, to scratch it. The complete effectiveness of the seal is then destroyed and, in some instances, this can necessitate scrapping the seal. Mechanical seal manufacturers receive complaints about bad seals which are traced back as being entirely the fault of poor handling. In this respect mechanical seals can claim a close relationship to ball bearings in that they are both extremely susceptible to improper treatment in the installation period.

Fortunately, the refinery industry maintenance personnel are the best trained, as a group, to be found anywhere, so that seal failures from poor handling are at a minimum, but, outside this area of operation, most early, unexplained failures are eventually traced back to defective handling, installation or maintenance.

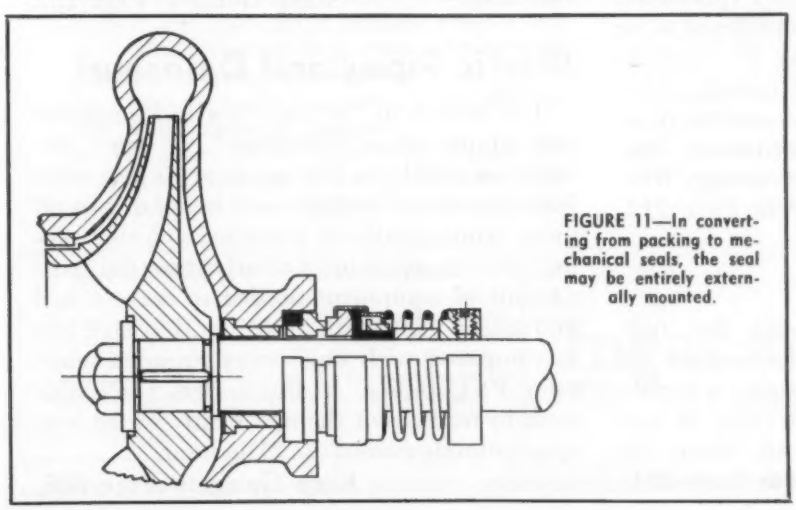
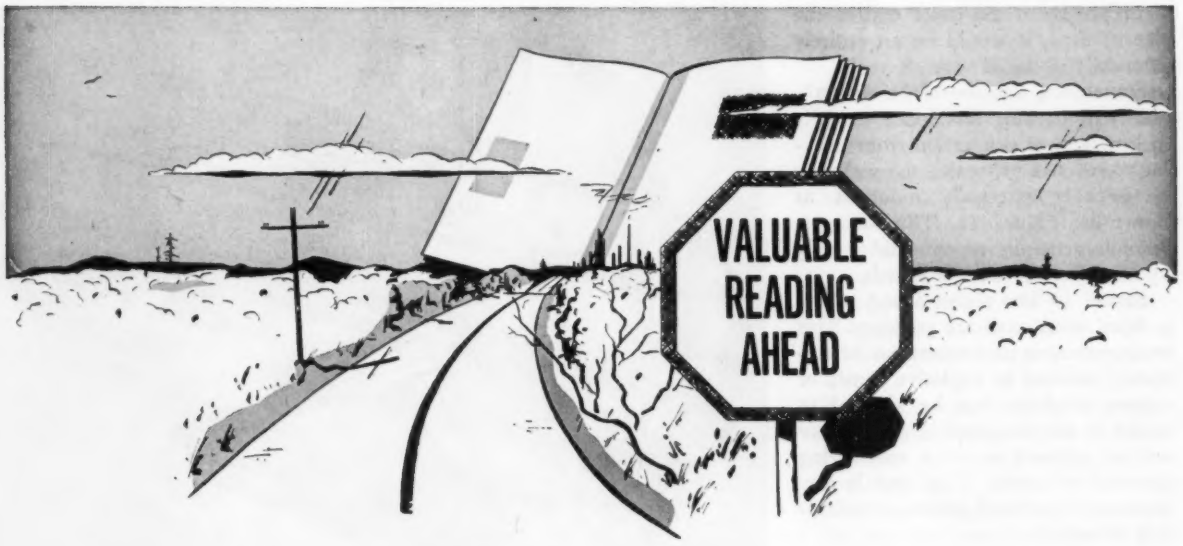


FIGURE 11—In converting from packing to mechanical seals, the seal may be entirely externally mounted.

Part 4 of this series will appear in a coming issue of ***PETROLEUM REFINER****.*



Can You Design a Death Ray?

If you can (or if you already have), you're the person the armed forces is looking for. They also need a non-magnetic compass, a snow track eraser, and an ingenious method for transmitting intelligence that is undetectable except by the desired receiver. These are just a few of the many items that are needed to solve some of the problems that for many years have baffled the armed forces. Read about these, then maybe you can tell the armed forces "How To Do It."

Keep Going to Page 218.

"Facts About Oil"

One of the books covered in this months' "Reviewing New Books" is the American Petroleum Institute's revised "Facts About Oil." Where oil men and industry spokesmen are concerned, this booklet is considered to be an excellent source for meeting the requests for specific information on petroleum. Also, six other excellent books are reviewed as briefly as possible for your information. This month, be sure to read "Reviewing New Books." **Keep Going to Page 214.**

First In Kansas

Vickers Petroleum has slated the first petrochemical plant by an oil company in Kansas. Read the details of this plus a rapid-fire summary of construction activity in our mushrooming industry. It's all there in "Who's Building." **Keep Going to Page 224.**

It's "Boxscore" Time Again

Yes, this month PETROLEUM REFINER again presents "Construction BOXSCORE," the quarterly tabulation of refinery-petrochemical-natural gasoline plant construction projects from all over the world. And don't fail to read the story just preceding BOXSCORE. It will give you a clear insight as to the tremendous amount of building that is taking place along the West Coast, and why this is so. **Keep Going to Page 237.**

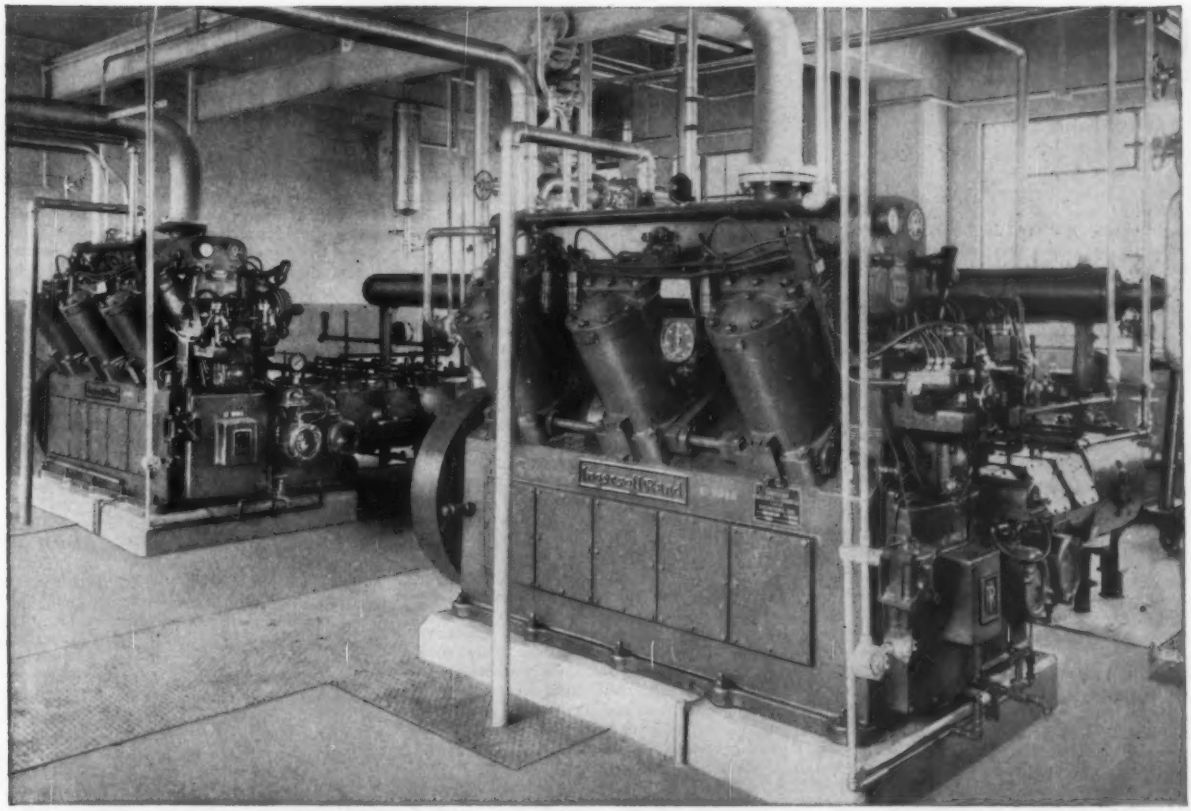
WPRA Elects

Get the background of the new president of the Western Petroleum Refiners Association by reading "What's Happening Among Men in the Industry." This section is your monthly roundup of the activities of your friends and this is so. **Keep Going to Page 237.**

Plastic Pipes and Dinosaurs

This month in "What's New in Equipment and Manufacture Literature" we have featured an article on how spent acids and other liquid wastes of industry are being drawn off more economically in polyvinyl chloride piping. Two large pictures clearly show the large amount of equipment needed to make a bell and spigot joint in an alloy cast drainage line as compared with equipment needed when using PVC piping. In this section you'll also want to read about the new catalyst loader so appropriately named the "Dinosaur."

Keep Going to Page 356.



Where a lube-oil plant couldn't use its own product

Although Imperial Oil Limited's new Edmonton (Alberta) plant produces 70,000 gallons of lubricating oil per day, its compressor pistons must run dry.

Of course there is no shortage of oil at Imperial, but the Hydrofining treatment process requires that hydrogen be recycled with no trace of oil being picked up. As in many other catalytic refining processes, any compressor oil carried by the hydrogen would soon reduce the effectiveness of the expensive catalyst.

To recycle the hydrogen without possibility of oil contamination, Imperial uses two heavy-duty Ingersoll-Rand JVG-NL gas-engine compressors featuring special compressor cylinders which are non-lubricated—no oil or other lubricant is used in the cylinders, so none can get into the hydrogen.* Of course, the running gear and the rugged 4-cycle engine end of each unit has oil lubrication.

The 13-million-dollar Imperial plant also employs many other products supplied by Canadian Ingersoll-Rand Co., Ltd., including stationary compressors (with gas-engine, electric, and steam drives), blowers, portable compressors and centrifugal pumps. Ingersoll-Rand builds equipment to suit your needs, too. Call your I-R representative today.

* ***Ingersoll-Rand 'NL' compressor cylinders***

Non-lubricated cylinders are specially-built for jobs where oil-free compression is necessary. Regular oil-lubricated compressors should be used where possible because of their lower cost and maintenance, but for applications where non-lubricated compressors are indicated, the most highly-developed and successful units are NL compressors, built by Ingersoll-Rand—the pioneers of non-lubricated construction.

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Reviewing New Books . . .

"Facts About Oil"

Brought up to date with the most current figures available, this new edition has been published by the American Petroleum Institute, and is now being distributed throughout the petroleum industry.

Where oil men and industry spokesmen are concerned, the booklet is considered to be an excellent source for meeting the requests for specific information on petroleum.

The new edition is substantially the same as its predecessors, except that its figures have been up-dated.

(API District Offices, or Main Office at 50 West 50th Street, New York 20, free bulk copies available at $25.00 per hundred.)

"Natural Motor Gasoline Survey, Summer 1956"

This report on the properties of motor fuels sold through service stations in the United States was made in accordance with a cooperative agreement between the American Petroleum Institute and the Bureau of Mines of the United States Department of Interior. By agreement with the American Petroleum Institute, identification of the items is confidential.

It represents analytical data for 4,457 samples, representing the products of 92 companies. The samples were collected by companies during June, July, and August 1956. As in previous surveys, the gasolines covered by this survey include those from both large and small suppliers.

"Chemical Process Economics"

This handy, useful little book records the proceedings of the fourth "Experience in Industry" Symposium jointly sponsored by the Philadelphia Wilmington section of the American Institute of Chemical Engineers and the School of Chemical Engineering, University of Pennsylvania.

Nine recognized experts in the economics of chemical process industries discuss: accounting terms, meanings and practices in industry; factors comprising total initial capital required for a process unit and some pitfalls of cost accounting; indirect investment and costs of services attending a processing plant; methods used to distribute indirect process costs; the relationship of price to value consolidation of various factors into a concise, interpretive profit picture; and methods of financing the original cost and operation of a new plant.

Throughout the book, emphasis is on the practical aspects of the subject—the terminology and methods of the accountant and the economist as they are actually used in the process industries. Engineers and management men, particularly those who have recently entered industry, will learn from this book many of the ways the engineer and the economist profitably employ each other's talents and work together creatively.

(Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y., 115 pages, $3.95. For sale by Gulf Publishing Co., P. O. Box 2608, Houston, Texas.)

Developments . . . Techniques . . . Ideas

POLYETHYLENE

By J. B. Allison

First organized account of all types of polyethylene. As far as possible in such a rapidly moving field, the book integrates structural observations, manufacturing conditions, properties and suitable fields of application. 564 pages, 1956 (High Polymers, Vol. XI).

228 illus. . . . . Price $16.00

ORGANIC CHEMISTRY

By Louis and Mary Fieser

Third Edition of this important work. It develops in orderly sequence, the principles and concepts of modern organic chemistry and applications of the fundamental science to technology, bio-chemistry.

1150 pages, 1956. . . Price $10.65

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1956-57 PETROLEUM BOOKS CATALOG

THE CHEMISTRY OF PETROCHEMICAL REACTIONS

By Lewis F. Hatch

An immediate and valuable reference for those engaged in the chemical or refining industry.

192 pages, 1955. . . . . Price $4.50

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API Standard 610-Specifications For Centrifugal Pumps for General Refinery Services

This second edition now includes supplements 1 and 2, and has been raised to a full standard. It specifies minimum requirements for centrifugal-type pumps for petroleum products. The section on design covers motors, turbines, casings, impellers, nozzles, flanges, bearings, stuffing boxes, mechanical shafts and shaft sleeves, shaft seals, couplings, baseplates, bolting, wearing rings, and running clearances. Inspection and tests (hydrostatic, running, and net positive suction head), preparation for shipment, drawings and other data required, and proposals are also specified.

(American Petroleum Institute, 50 West 50th Street, New York 20, N. Y., $1.50.)

"Chemical Engineering Reports"

This book by *Kenneth A. Kobe* is the outgrowth of a course given since 1942 at the University of Texas by a noted teacher of chemical engineering. Its use, in mimeographed form, has spread since then to a number of other schools of Chemical Engineering.

Now revised, in the light of this very considerable teaching experience, the book tells the young engineer, starting his professional career, how to present a report to his superiors in a form which conveys an impression of professional competence.

Among other things it includes sections on literature search, types of reports, the business letter, and the recommended style of an engineering report.

(Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y., 183 pages, $3.00.)

"Organic Synthesis"

Printed in two volumes, this up-to-date presentation of organic synthesis by **Vartkes Migrdichian** puts great emphasis on later advances including reactions like halogenation, nitration, sulfonation, and diazotization. Chapters dealing with the olefins and acetylenic compounds are complete essays in themselves on these timely subjects, and more inclusive than any previous exposition. The book also deals concisely with information on sterols, carotenoids, vitamins, peptides, carbohydrates, terpenes, azulenes, and tropolones. This is the first general reference which accords full details to these comparatively new fields.

(Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y., 1832 pages, $35. For sale by Gulf Publishing Co., P. O. Box 2608, Houston, Texas.)

"Petroleum and Its Products"

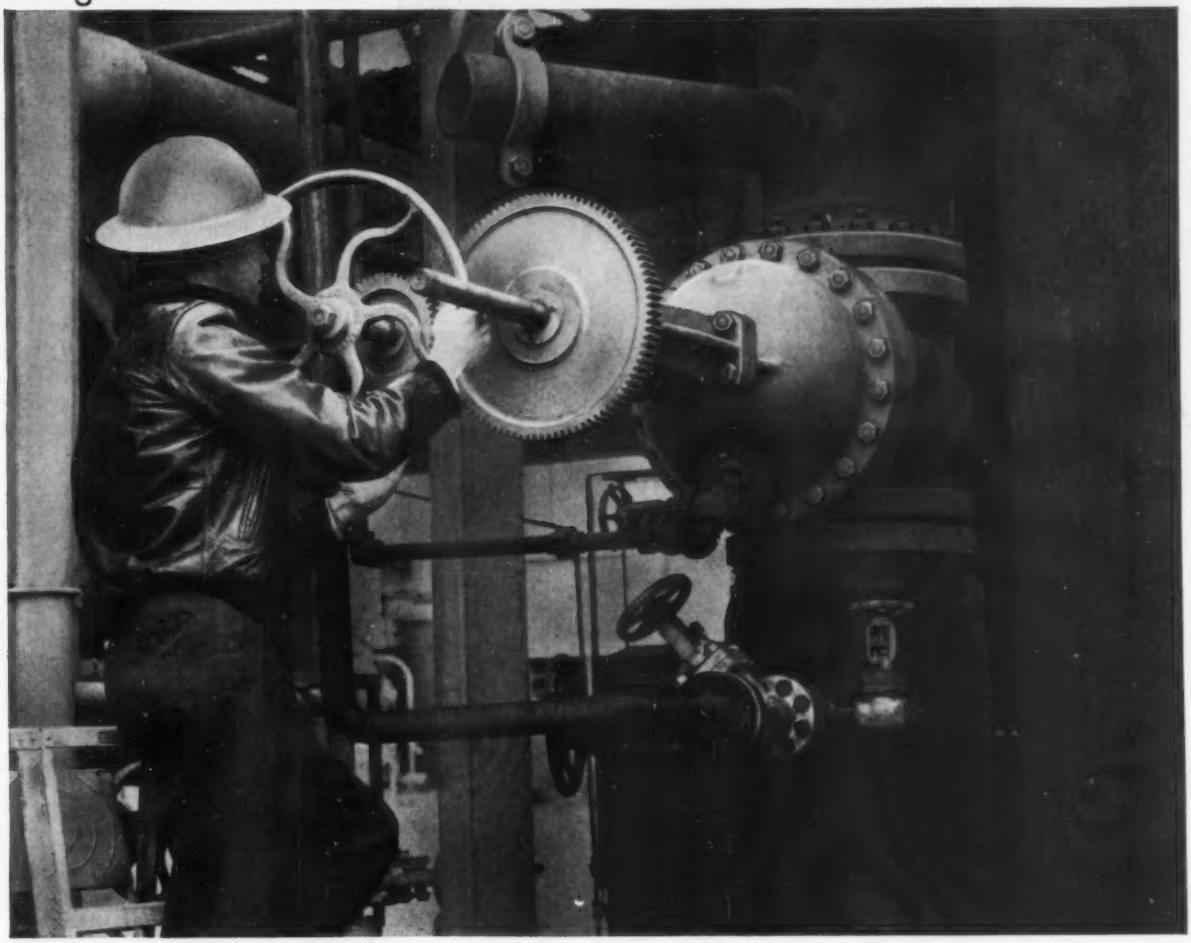
This book by **J. H. van der Have** and **C. G. Verver** explains the "how" and "why" of the various methods employed for bringing crude oil to the surface, and converting it into finished products.

It reviews the whole field of petroleum production and refining, describing the exploration and drilling for petroleum, the composition of the various kinds of crude oil, the manufacture and the numerous derivatives that are made from it and the properties that these products should possess.

The student and the general reader who wants to learn something about the background of the subject—but who does not wish to wade through a mass of highly technical details—will find that this book meets his requirements.

(Pitman Publishing Co., 2 West 45th St., New York 36, N. Y., 421 pages, $10.)

Single Crane Valve Gives Double Valve Protection



Look, man!—one valve and no blind gives positive isolation of any line

Phillips Petroleum Co. engineers wanted safe, efficient valve operation during regeneration cycling in the new unit at their Borger, Texas, refinery. They installed Crane steel gates modified with the Crane-designed flexible disc.

These valves safely isolate the regenerating gas from the gasoline vapors while desulphurization reactor chambers are regenerated. Gasoline vapors are processed at 90 psi and 700 deg. F. Steam and air for regeneration are at 15 psi and 900 deg. F.

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Equipped with bonnet vent lines to atmosphere, the valves provide for drainage of fluids trapped in body. During on-stream cycle they prevent gasoline vapors from entering the stacks.

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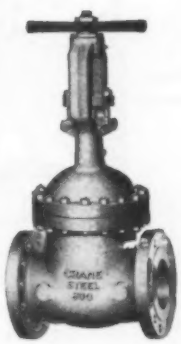

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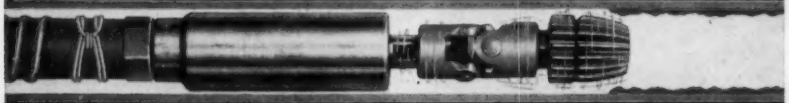

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quickly and effectively

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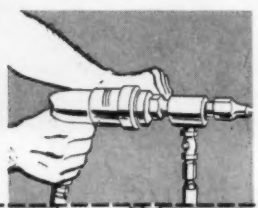
These air- or steam-driven motors are excellent for routing light scale in tubes with inside diameters from 5/8" to 1 3/4". Various types of cutter heads and brushes are available for specific tube cleaning requirements.



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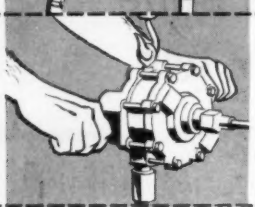
Air-driven motor with trigger action for motor control, finger-action valve for water flow, built-in speed governor and oil reservoir. Two sizes.



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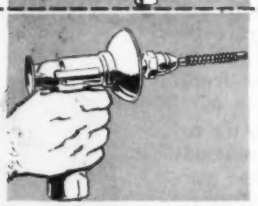
Air, steam, or electric motor drives shaft fitted with drill or brush head. Motor is suspended outside, shaft and head enter tube.



ELLIOTT JIFFY GUN for extra-fast cleaning of light accumulations

Simply insert nozzle into tube and push. Released air or water pressure shoots nylon brushes or rubber plugs through condenser or heat exchanger tubes. For tubes 1/2" to 1".

For details on Elliott tube cleaning and maintenance equipment, contact Elliott District Office or write Elliott Company, Lagonda Division, Springfield, Ohio.

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Cooling Water Corrosion . . .

Continued From Page 164

phate in the system, even though rigorous pH control is attempted.

Zinc salts and certain organic chemicals such as quinoline-ethiodide are cathodic inhibitors but most of them are very expensive and not too efficient in lowering the total corrosion rate although they do a good job in preventing pitting. In the last few years, attempts have been made to formulate true "cathanodic" inhibitors by combining zinc salts with chromates. These attempts have been successful in some cases but they have not proved to be satisfactory in others.

Example Data. Though Equation (7) contains constants that must be evaluated for each individual cooling system, the following information, taken from actual experimental data, demonstrate the increase in corrosion rate with increase in conductivity (or total dissolved solids).

TABLE 1
Corrosion Rate vs NaCl Concentration

Salt Concentration—ppm.	0	3,000	15,000	30,000
Corrosion Rate—Mdd....	15	18	20	25

The above rates were for carbon steel exposed four days at 95 F.

TABLE 2
Example Data for Inhibitors

Treatment	Anodic (Phosphate) (Low pH)	Double Anodic (Phosphate) (Chromate)	Cathanodic (Zinc-Chromate)
Corrosion Rate—MPY.....	11.20	7.10	3.78

Table 2 shows a comparison of fairly weak anodic inhibitors of the phosphate type, double anodic inhibitors of the chromate phosphate type and a cathanodic inhibitor. The corrosion rates reported were taken from actual field corrosion studies. All were run in the same industrial cooling system under comparable conditions and are the average of two consecutive 300-hour tests. The phosphate results are the average of two such determinations using different inhibitors of the phosphate-low pH variety. The chromate-phosphate values also are the average of two runs on different inhibitors of the double anodic type. The results on the cathanodic inhibitor are the average of two runs on the same inhibitor.

##

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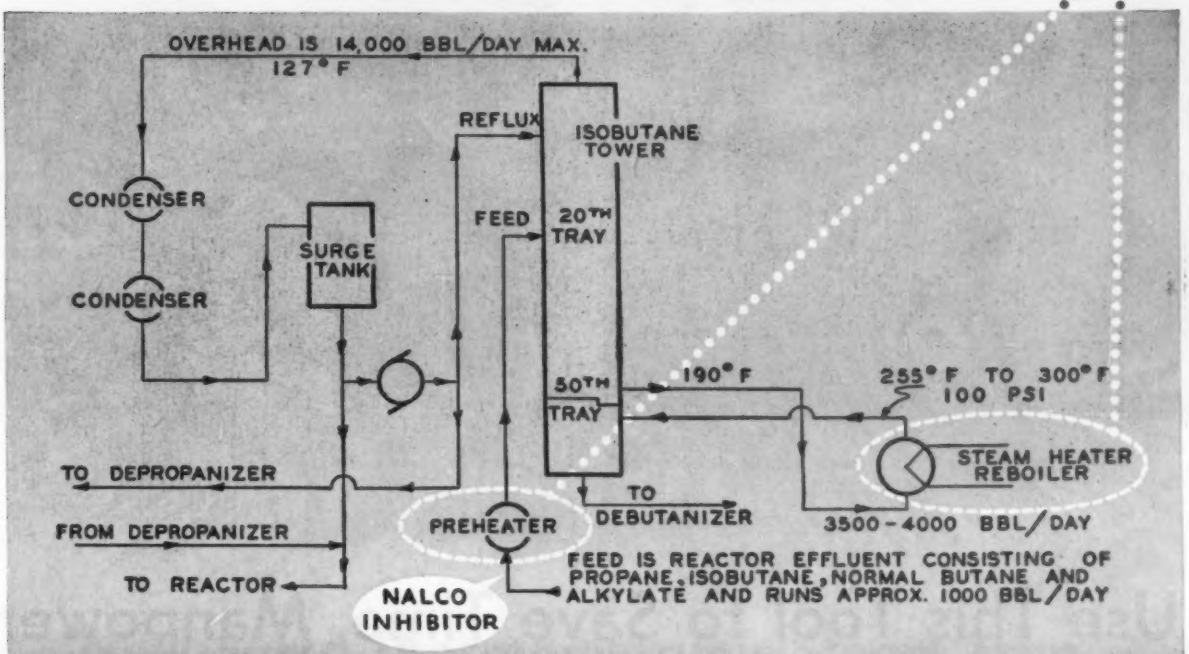
Nalco INHIBITORS GET RESULTS AT THESE TYPICAL TROUBLE-SPOTS

IN AN H_2SO_4 ALKYLATION SYSTEM



THE PROBLEM	THE TREATMENT	THE RESULTS
1. *Corrosion* in the preheat exchanger of the isobutane tower. 2. *Fouling* with ferric sulfate and hydrolysis products of esters of H_2SO_4 in the reboiler of the isobutane tower.	Nalco Inhibitor fed to the isobutane tower at first month rate of 20 ppm with subsequent reduction to 10 ppm.	Reboiler pressure drop held to 25-28 psi. No decrease in reboiler coefficient. No problem of corrosion or deposits during more than a year of operation with Nalco treatment.

When corrosion and fouling start to limit refinery production, you can rely on fast, thorough Nalco chemical action to effect a cure.

The earlier the treatment, of course, the simpler the problem, so if you are beginning to detect corrosion and fouling, let your Nalco Representative help you *now* or write direct for further information.

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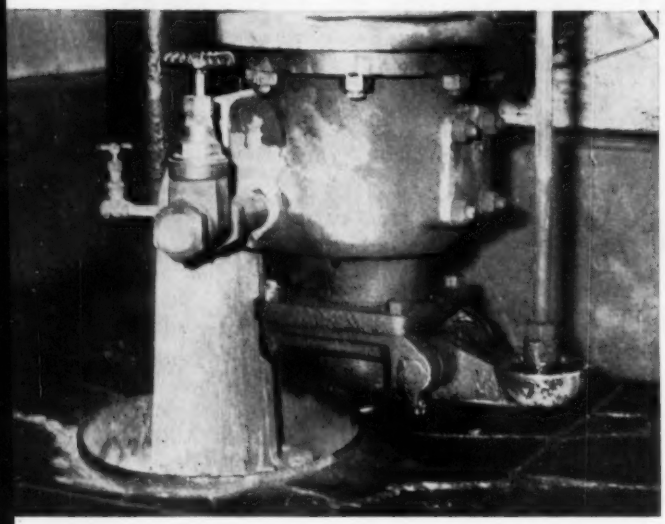
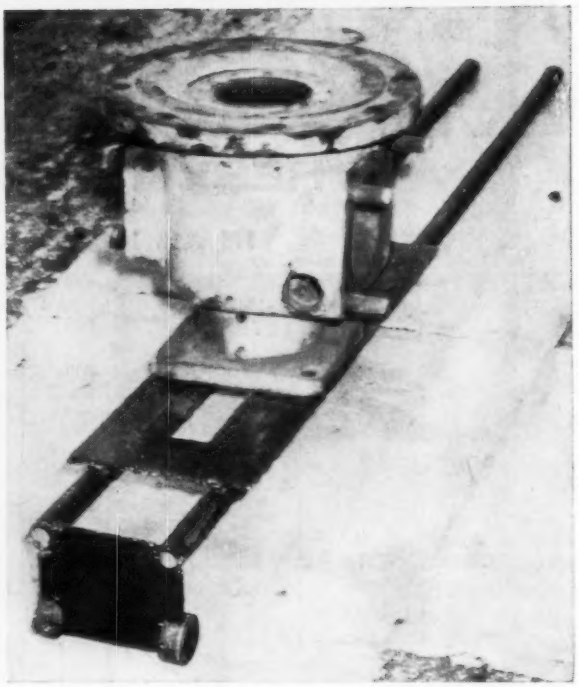
How To Do It . . .





Valve cage easily positioned . . . with home-made tool

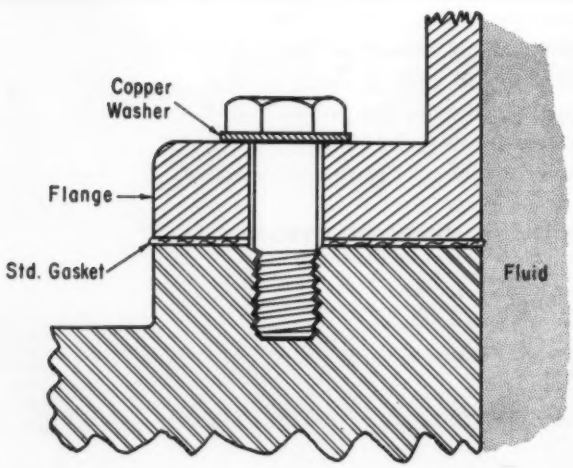
Use This Tool to Save Time, Manpower

The ingenuity of two employees at the Lone Star Gas System's Pueblo gasoline plant has resulted in a saving of manpower, equipment, time and has reduced the likelihood of an accident.

The tool is used to lift a valve cage into position so that it may be fitted under the power cylinder of a type 75 Cooper-Bessemer engine. It replaces the old method of using a 4 x 4-inch block, two bars and three men. Only one man is needed now to do this operation safely and quickly.

The tool, constructed of steel pipe, is mounted on rollers. The rollers help slide the tool under the cumbersome valve cages which are located near the floor under the power cylinder.

This idea was submitted by:
J. C. Hess
Cisco, Texas



Convenient Seal Reduces Leaks at Flange Bolts

To help solve those housekeeping problems caused by fluid seeping through flange bolt holes, one repair foreman came up with this inexpensive remedy. With a piece of scrap copper from an old rectifier and a set of gasket punches, he fashioned this convenient seal.

Fluid may frequently seep out through the threads of a bolt by easing past the narrow gasket surface next to the bolt or by following the threads, when the bolt or stud is extended all the way through the tank engine or other casting. When the copper washer is compressed by the bolt head, a satisfactory seal is obtained eliminating one more nuisance.

The labor and material used are negligible when com-

New Sarco Thermodynamic Steam Trap practically eliminates maintenance!

Only moving part—a hardened Solid Stainless Steel Disc—practically wear-proof!

SOME OF MANY ADVANTAGES

1. Same trap for all loads and pressures 10-600 psi.

2. *Stainless steel throughout*...therefore immune to both internal and external corrosion; safe in fire hazard locations.

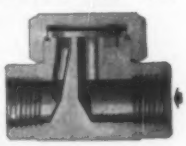
3. Closes tight on no load. Operates against back pressures up to 50% of inlet pressure.

4. Not affected by superheat, water-hammer, vibration.

5. Smallest inventory of spare parts.

SIMPLICITY—to the Nth degree!

No valve-closing mechanisms to wear or stick. No critical clearances to choke. No gaskets to leak. Three simple parts...machined from stainless steel bar stock. Only one moving part. What could be simpler?



SARCO COMPANY, INC.

2148-B

Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

Please send me: ☐ Bulletin 255-44
☐ A Sarco Thermodynamic Steam Trap for 60-day trial. Size_____ for installation on_____

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

For more data on advertised products, use Readers' Service Cards, last page.

THESE VALVES
control
surge
pressures
silently

Center-guided type for lines from 1" to 10".

Globe-type for lines from 3" to 24".

WILLIAMS·HAGER
FLANGED
Silent
CHECK VALVES

Surge pressures . . . and the resulting water hammer . . . are effectively controlled by these valves. Protection for pumps and piping systems is assured—a fact testified to by satisfactory service in every type of industry over a period of 28 years, in pressures up to 5,000 pounds.

Write for Bulletins:
No. 654 on the Valves
No. 851 on Cause, Effect and Control of Water Hammer

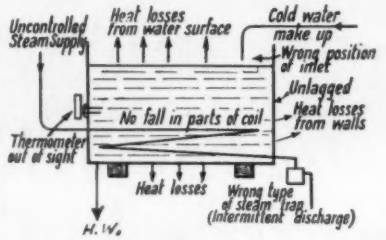
THE WILLIAMS GAUGE CO., INC.
151 Stanwix Street
2 Gateway Center Pittsburgh 22, Pa.
Our 71st Year • 1886-1957

How to Do It . . .

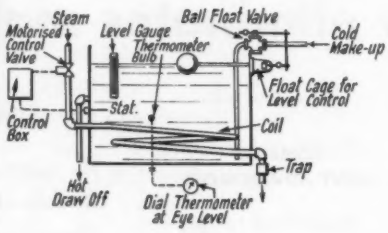
pared to the added assurance of a neat looking station area.

Here's How to Improve Your Hot Water Storage Tanks

Hot water storage for space heating or for processing purposes is often carried out in large rectangular tanks, having a steam heating coil inside. Such a storage vessel was in operation in a refinery, but not much thought had been given to its installation. It became obvious that the whole hook-up was inadequate. Steam supply was controlled by hand, depending entirely on the operator's attention. Sometimes he forgot to act, and either cold water or boiling water was supplied. The steam coil had no fall in the parts, with resulting water-logging. An intermittent discharge type of steam trap produced the same results. The cold water inlet was in the wrong position causing a temperature stratification. No lid on the vessel produced heat losses. The inaccessible thermometer could not be read from the floor. No insulation caused heat losses from walls and bottom of the vessel.



Before . . .



After

The Cure

All the above faults have been cured, with resulting savings of steam and perfect water supply.

A simple temperature regulator produced constant hot water temperature. A new dial thermometer with capillary tubing of the distant reading type was fitted, placing the instrument scale at eye level. The steam coil was taken out, re-shaped for continuous fall and discharge of condensate. A ball-float trap was fitted in place with pipeline strainer in front and sight glass afterwards, which is the correct trap installation method. The cold water inlet was brought near the tank bottom to secure good mixing of cold with warm water inside the vessel. The hot water outflow was removed from the tank bottom, where always the coldest water had been drawn. The outflow higher up on the side wall assured a continuous stream of hot water.

Finally, a lid was placed on the storage tank, well insulated, with hinges. Insulation was placed on outside walls and bottom of the tank.

Maybe You Can Tell the Armed Forces How to Do It

Just as the oil industry needs new ideas from practical inventors, the U. S. Department of Commerce is asking for solutions to the following problems which have baffled the armed services.

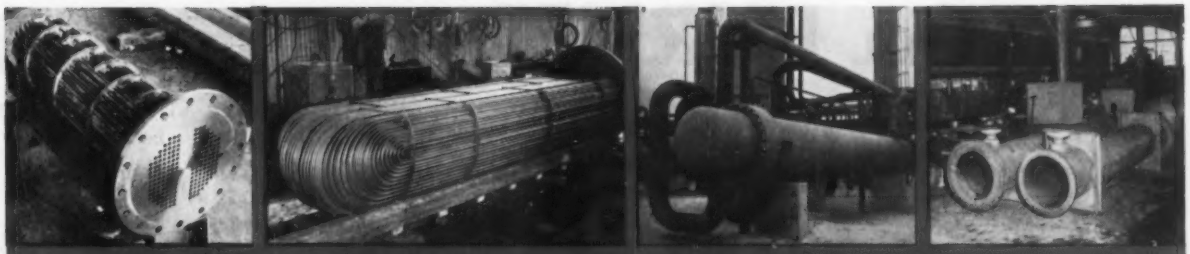
These nine revolutionary ideas are needed by the armed services:

Non-magnetic Compass. A device which can determine true north, independently of the earth's magnetic field, yet which is small enough to be carried by a man on foot. Better still, it should enable a man to determine his position accurately.

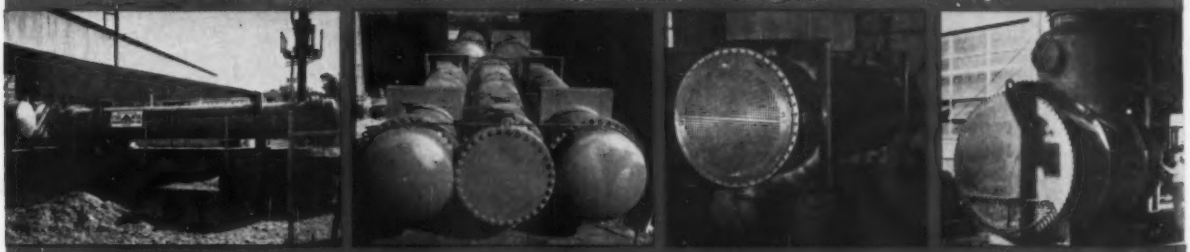
Explosive Mine Detector. A method for locating explosives buried at shallow depths below the earth's surface. Present detectors locate the explosive's container or signal the presence of a hole in the ground.

Method for Converting Light Into Electrical Energy. An invention which will convert a small amount of light into enough electricity to operate electrical equipment. Far greater power output is needed than has as yet been supplied by solar batteries.

Snow Track Eraser. A practical means of destroying the tell-tale tracks of men or vehicles across snow



Exchangers like these serve dependably throughout the industry.



We are proud to serve the

PETRO-CHEMICAL INDUSTRY

in Custom-Design, Fabrication and Repair of

HEAT EXCHANGERS

Qualified for Construction in Ferrous and Non-Ferrous Materials

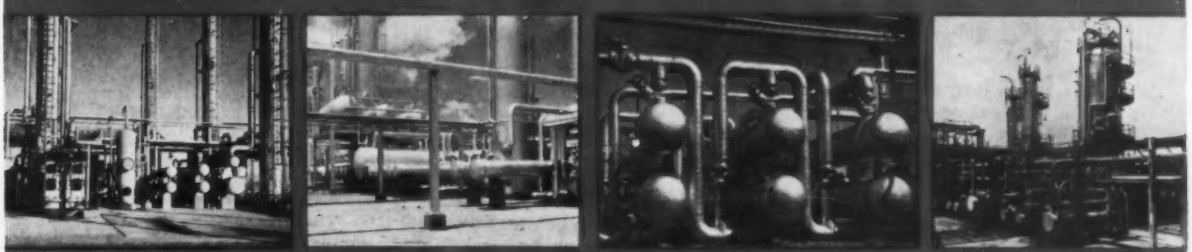
MTF

API-ASME and ASME Code Construction

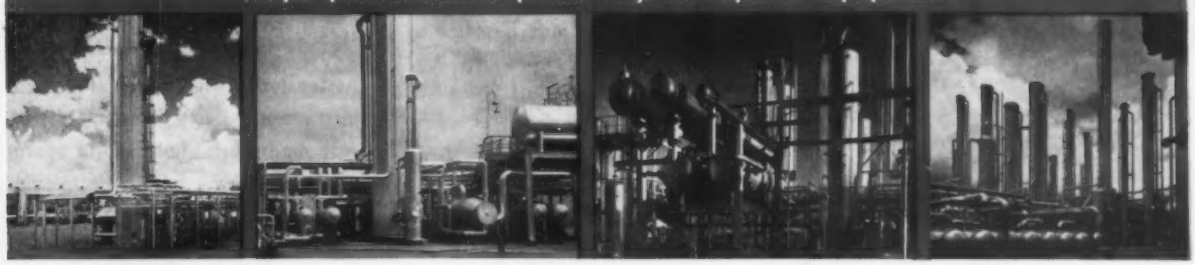
Your inquiries are cordially invited.

TEXAS METAL FABRICATING COMPANY

P. O. Box 7567, Houston 7, Texas



Major petro-chemical plants rely on superior equipment.



For more data on advertised products, use Readers' Service Cards, last page.

WE SELL BURNER *Engineering*

John Zink engineering is the answer to your burner problems. In thousands of installations John Zink gas, oil and combination burners have proved their merits by years of satisfactory service.

John Zink engineering has been the answer to countless special problems, such as:

- Famous JZ Smokeless Field Flares . . . in use wherever smoke or smog is a problem.
- JZ Sludge Burners . . . an answer to waste disposal for chemical plants.
- JZ Inert Gas Generators . . . for increased safety in process plant operations.
- JZ Ultra-High Temperature Air Heaters . . . for research programs.

WE MAKE HEAT . . . AROUND THE WORLD

Throughout the world John Zink engineering is working for the petrochemical industry. Why not put it to work for you? Inquiries on burners for special application are always welcome . . . and the John Zink research furnace provides excellent testing facilities for new designs.

For information on the full line of John Zink burners, write for catalog REF-57.

JOHN ZINK COMPANY

4401 SOUTH PEORIA TULSA 5, OKLAHOMA

How to Do It . . .

fields. Object is to restore original contour of the snow field to avoid air detection.

Destructive Ray or Wave. Equipment of usable size capable of producing death rays effective at 500 yards, without excessive power. Investigations so far indicate that a completely new approach is needed.

Universal Track. A new method of traction for land vehicles for use on all types of terrain. Present steel tank tracks wreck paved roads.

Radical Method for Unloading Ships. New means of quickly discharging large quantities of military supplies from commercial or military vessels, either over the beach or at dockside.

Vehicle Black-out Devices. Inventions to mask the light, noise and radiation from combat vehicles operated under cover of darkness.

New Type of Communication. An ingenious new method of transmitting intelligence, non-detectable except by the desired receiver. The military is seeking a new principle which does not use electrical impulses, electromagnetic waves or sound waves.

If anyone can come up with a practical idea for meeting one of these military objectives, he is encouraged to mail his solution to the National Inventors Council, U. S. Department of Commerce, Washington 25, D. C. Complete lists of hundreds of technical problems affecting the national defense may be obtained by writing to this same address.

Here's A Quickie— Camphor Flake 'Sees' Oil

Pure water will support a flake of camphor. If oil is present on the surface, the camphor flake will not float.

This simple test will allow the operator of an oil removal unit, in a condensate return system, to sample the condensate and quickly determine the presence of oil.

YOUR IDEAS ARE VALUABLE!

At least $10 will be paid for each idea accepted for "How to Do It." Just send a brief note with a photo or sketch to the Editor, *Petroleum Refiner*, P. O. Box 2608, Houston.

For more data on advertised products, use Readers' Service Cards, last page.

Mill scale removal by Dowell started this new plant off with a $100,000 operating profit

Here's how the management of a multi-million dollar corporation used its knowledge of chemical cleaning to start a new plant off in the right way—in the black.

Following construction, and before the plant was put on stream, Dowell was called in to remove mill scale from the following systems:

• Ammonia Compressors Suction and Discharge Piping • Engine Water-Cooling System • Engine Oil-Cooling System • Engine Jackets • Hydraulic Oil-Cooling System • Oxygen Suction and Discharge Piping • Miscellaneous Piping • Product Lines to Storage • Miscellaneous Towers

The total cost of this mill scaling was approximately $5,000. But, once in production, this plant did not have a single major shut down for maintenance caused by mill scale. The plant management credits Dowell Service with netting the plant an operating profit somewhere between 10 and 20 times the cost of the chemical cleaning. This amounted to between $50,000 and $100,000 the first year.

This particular case history is about a chemical company, but Dowell has startling performance data to show you—from your own industry. That's because chemical cleaning is so versatile. Dowell engineers are experts in removing scale and sludge from process systems, tanks and piping. They apply solvents in various ways—such as filling, jetting, cascading. Dowell furnishes all the necessary chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office near you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

have Dowell clean it chemically DOWELL

A SUBSIDIARY OF THE DOW CHEMICAL COMPANY

For more data on advertised products, use Readers' Service Cards, last page.

Who's Building . . .

Construction BOXSCORE Begins on Page 237

Aromatics to Come from Kansas Plant

Vickers Petroleum will be first oil company to build petrochemical plant in Kansas.

Construction of the first petrochemical plant by an oil company in Kansas will begin this month at The Vickers Petroleum Co., Inc., Potwin, refinery. Completion has been set for January 1958.

The $2 million petrochemical plant will be an Udex extraction unit which will be designed by Universal Oil Products Co. and constructed by Procon, Inc., both of Des Plaines, Ill.

The complex Udex extraction unit will remove the aromatic hydrocarbons in the reformate resulting from the catalytic reformer now under construction at the Potwin refinery. Aromatics that will be manufactured by the Udex extraction unit will include benzene, toluene, and xylene.

The chemical raw materials derived from Vickers' new petro-chemical plant will be used extensively in the production of synthetic rubber, plastics, medicines, food preservatives, synthetic resins, explosives, paint and lacquer solvents and in certain synthetic fibers.

Over 15 million gallons of chemicals will be produced annually and consequently one hundred new tank cars have been ordered for early 1958 delivery to be used in the transportation of the chemical raw materials to the major consuming areas.

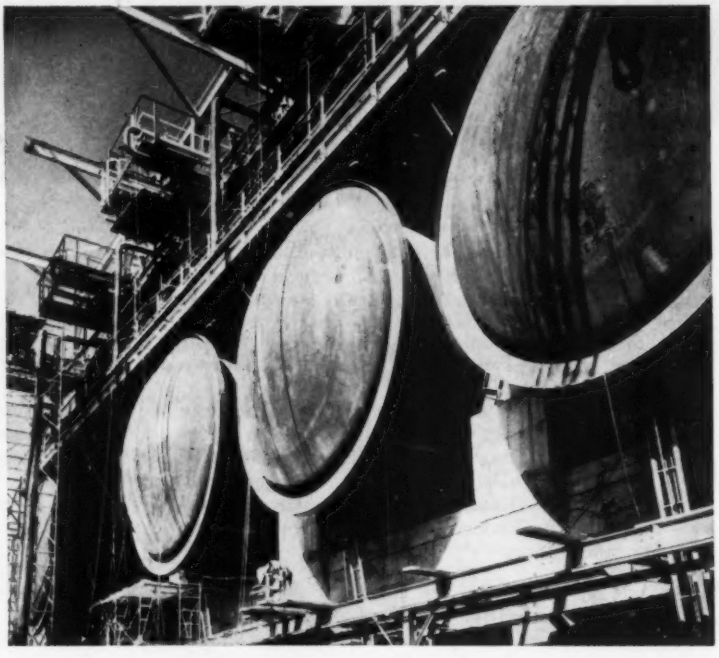
The Udex BTX petrochemical plant is the latest move in a Vickers program of expansion which began in 1952 with the completion of a $500,000 pipeline from the Vickers refinery at Potwin, to the Great Lakes Pipe Line in El Dorado, Kan. This link enabled the firm to move products as far north as Minnesota and the Dakotas.

In 1953, a Thermofor Catalytic Cracking unit was completed at the Potwin refinery at a cost of around $4 million which not only stepped up throughput to its present capacity of 15,000 barrels daily but enabled Vickers to produce high quality refined products.

Now under construction at Potwin and expected to be on stream by midsummer is a $1 million Ultraformer with a daily capacity of 3500 barrels which, while not increasing plant throughput, will enable the company to control product quality and keep octane ratings above and beyond the forecasted requirements as set forth by the automotive industry.

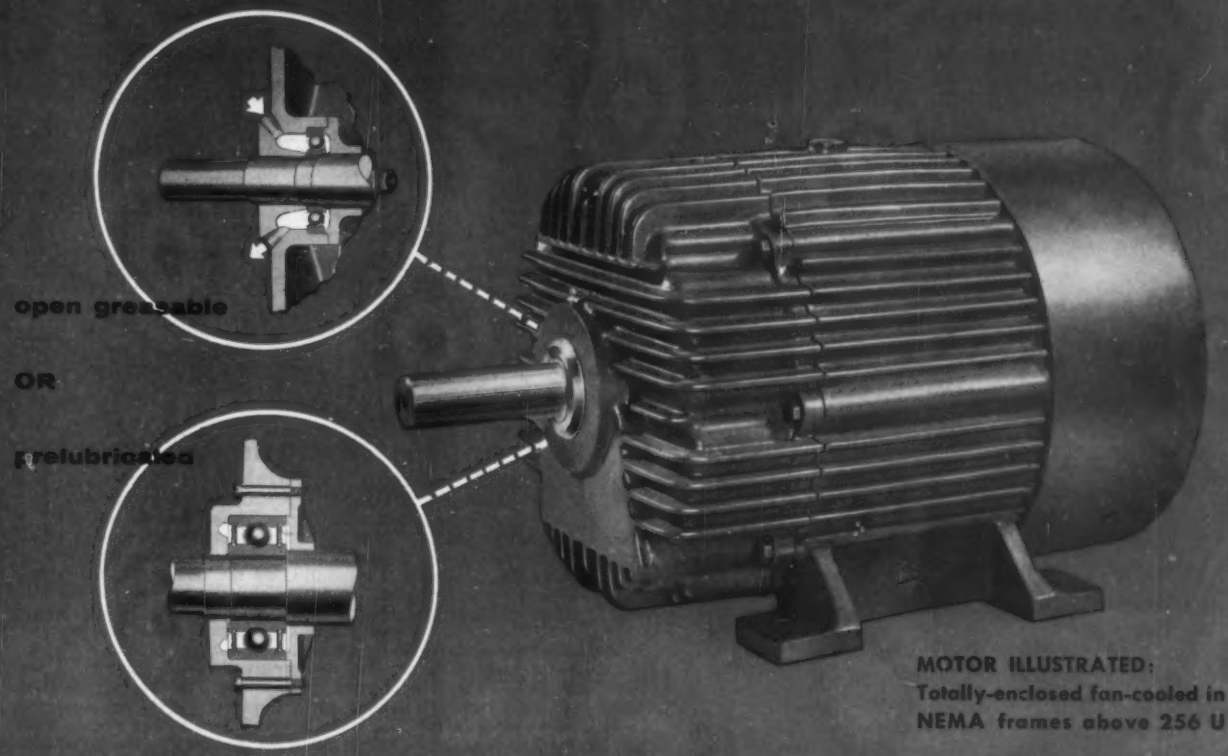
J. A. Vickers, president of The

Firestone Reactors



Reactors form an integral part of The Firestone Tire & Rubber Company's butadiene plant under construction at Orange, Texas. The 40,000 ton capacity plant is the first butadiene plant to be constructed solely by a rubber company. It is scheduled for completion this month. Butane supplied from Texas oil fields will be processed to form butadiene for the production of synthetic rubber. The finished product will be shipped to the company's Akron and Lake Charles, La., plants.

YOUR CHOICE of motor bearings . . .



—when you specify ELLIOTT Crocker-Wheeler Type N integral horsepower motors

Whatever your operating conditions or maintenance practice, Crocker-Wheeler offers the motor bearing best adapted to your needs or preference.

The Open Greasable type
requires only infrequent lubrication. All old grease is positively flushed out, eliminating risk of forcing grease into motor interior. An external grease reservoir helps seal and protect the bearing. The inner cap and grease reservoir prevent rust or corrosion from within.

Prelubricated bearings
are furnished for applications requiring operation without regular service lubrication. They are sealed cartridge-type, factory grease-filled, with inner protective cap.

Choice of bearings
is another design feature of the new Elliott Type N motor line. These motors are honestly new—inside and out. We think you'll agree that they incorporate every important feature that distinguishes a modern motor.

W7-1

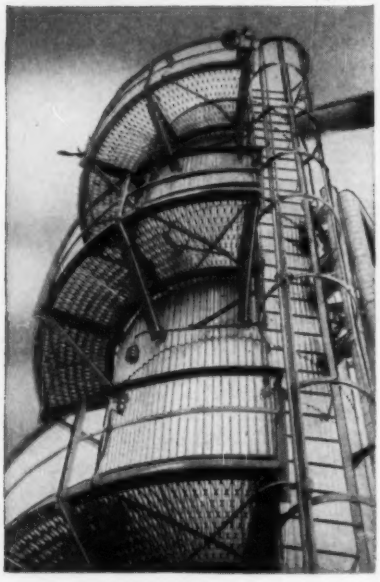
OTHER C-W TYPE N MOTOR ENCLOSURES

Totally-enclosed non-ventilated | Dripproof Protected | Totally-enclosed, fan-cooled Frames 256 U and smaller

ELLIOTT Company
CROCKER-WHEELER DIVISION
Jeannette, Pennsylvania

We will be glad to send a copy of this new booklet describing the complete line of Elliott C-W type N motors. Ask for Bulletin PB 6000-6.

RAIN OR SNOW CAN MAKE CATWALKS DANGEROUS



Walkways, catwalks and treads made of solid wood, metal or other material can collect snow, rainfall, grease or oil and become dangerously slippery.

But these walking surfaces, made of an open mesh of metal bars on edge, cannot collect these substances, leaving the surface always *clean*, dry and tractional for safer access to high places.

As founders of the grating industry, the Irving Company can draw upon over half a century of experience to supply you with quality grating products for catwalks, treads and other practical and economical uses.

"A FITTING GRATING FOR EVERY PURPOSE"

Write for our General Grating Catalog.

IRVICO

IRVING SUBWAY GRATING CO., Inc.
Originators of the Grating Industry

Offices and Plants at
5090 27th St., LONG ISLAND CITY 1, N. Y.
1890 10th St., OAKLAND 23, CALIFORNIA

Who's Building...

Vickers Petroleum Co., Inc., said, "The addition of the Udex petrochemical unit at Potwin will provide diversification in an increasingly competitive industry. Its addition is a natural step of expansion which has been contemplated for some time and which, in all probability, will provide the next step for further plant expansion and development."

Experts in the field of market research state the field of petrochemicals is growing four times as fast as the entire United States industry. According to reliable sources, one third of the total weight of chemical products manufactured in the United States by 1960 will be petrochemicals.

Scholven-Chemie A.G., a West German refining company, plans to increase the capacity of its Buer plant from 15,000 to 40,000 bpd. The refinery will be designed to produce 14,400 bpd of fuel oil. Expansion will be completed in two years.

BP (Canada) Ltd., a subsidiary of British Petroleum Co., Ltd., has announced plans for its first venture into oil refining and marketing in North America. The company will build a refinery on a recently acquired 600-acre site near Montreal, Canada. Capacity of the plant will be about 30,000-bpd.

Koppers Co., Inc. and **Brea Chemicals, Inc.,** have postponed construction of their previously announced $15 million polyethylene plant at Los Angeles. The announcement was made by Union Oil Co. of California, parent company of Brea.

Plans for the plant, to be owned on a 50-50 basis by Brea and Koppers, was first announced last March with a completion date for mid-1957, but more recently that date was changed to mid-1958. Now, the Union Oil spokesman indicated that the economics of the plant are under review.

Also affected by the postponement is a $7 million to $8 million ethylene plant which Union Oil Co. had planned to build at its refinery in the Los Angeles area. This

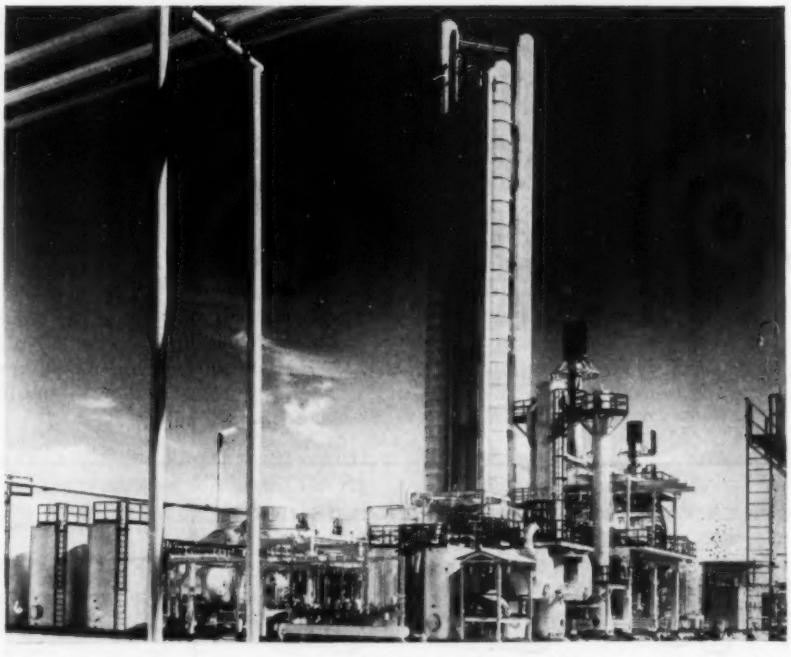
Unique Plant Prepares Styrene Charge

The world's first and only plant producing styrene by direct recovery of ethylbenzene from gasoline was officially dedicated early this month in formal ceremonies at Cosden Petroleum Corp. and Badger Manufacturing Co., Cambridge, Mass., were co-hosts to representatives of the press.

The four giant distillation towers, each nearly 200 feet tall, against a clear West Texas sky mark the fulfillment of an engineering goal of many years: the production of styrene without the synthesis of ethylbenzene. As industry authorities are well aware, synthesizing ethylbenzene is an exacting and costly operation.

William Rousseau, vice president of Badger, reported that his company had completed the $3 million unit in only 13 months—in spite of the steel strike last year which delayed construction nearly two months. By the end of the first day's run early in February, product purity was 99.2 percent. Present purity of the product is above specifications for plastic-grade styrene.

In the production of styrene at its model refinery in Big Spring, Cosden starts with a mixed xylene stream from its BTX plant. The ethylbenzene is then separated in the Badger Ultrafractionation columns with a critical boiling point differential of only four degrees between the stream constituents.



Four giant distillation towers are used in Cosden's process for making styrene from the ethylbenzene present in gasoline.

LUMMUS

ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

385 Madison Avenue New York 17, N. Y.

Lummus to Build 200,000,000 lb. per Year Ethylene Plant for Petroleum Chemicals, Inc.

Installation Designed for 50% Expansion

The Lummus Company is presently designing and will build for Petroleum Chemicals, Inc. at Lake Charles, Louisiana a plant to produce 200,000,000 pounds per year of ethylene. Scheduled for completion by the end of 1957, the plant is designed to permit expansion of output to 300,000,000 pounds.

The plant will use Lummus' ethylene process and will draw refinery gases supplemented with LPG from the nearby refineries of Cities Service and Continental Oil, by whom P.C.I. is jointly owned. Ethylene will be made in two grades — the top grade 99.8% pure — the second 98.5%. By-products will be 95% pure propylene, C_4s, and an aromatic distillate.

Cracking section of the plant features an improved Lummus heater which embodies years of research and development by Lummus' Heater Division. Equipment in the Lummus-designed low-temperature fractionation unit includes 12,500-hp gas turbines which drive the centrifugal charge and refrigeration compressors; exhaust from these turbines generates high-pressure steam in three waste heat boilers. The system utilizes high efficiency expanders to recover very low temperature refrigeration.

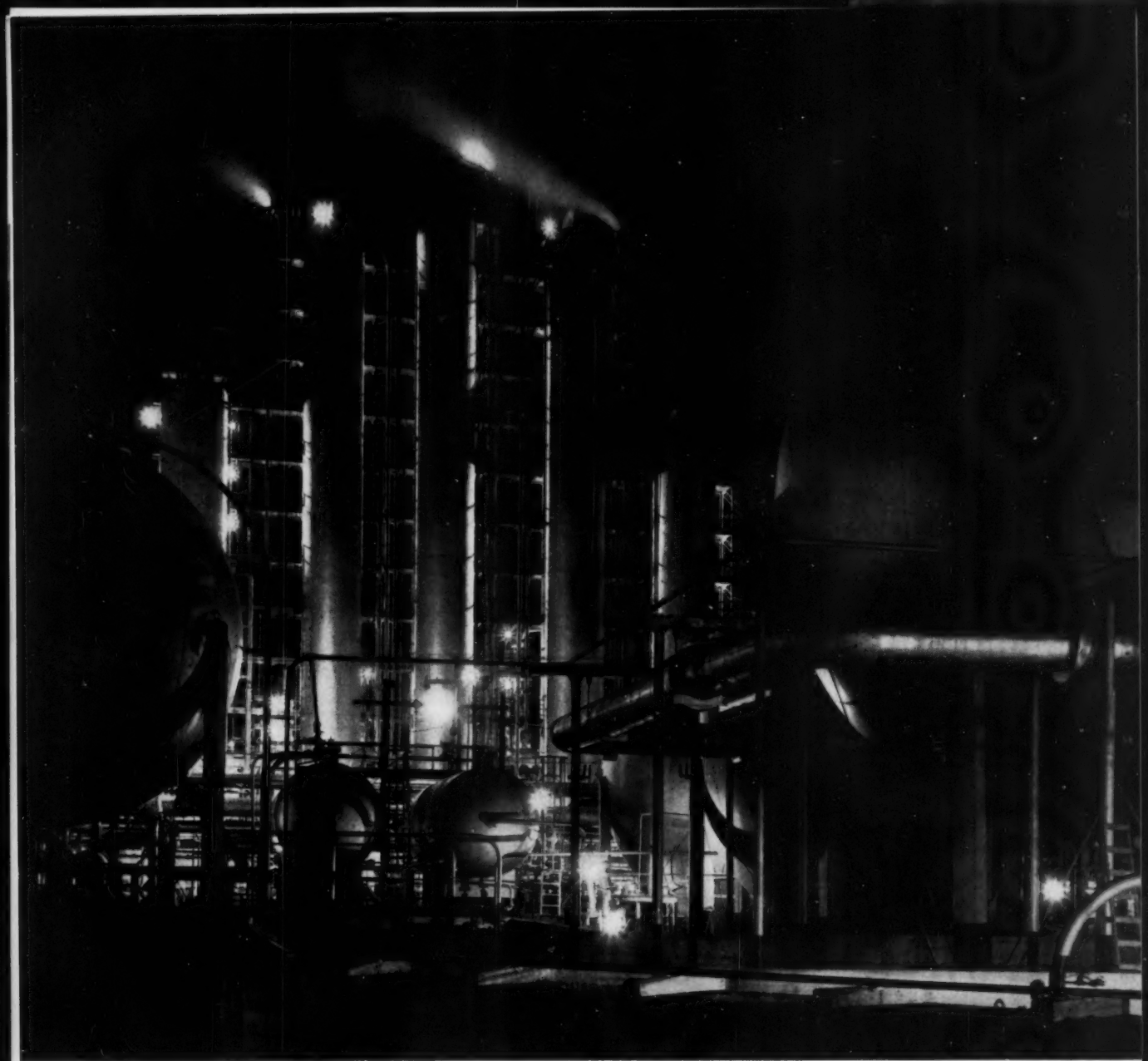
This plant brings the total of Lummus designed ethylene plants to 14, with a combined capacity of over 3 million pounds per day.

Part of the new plant's ethylene output will be sold to Calcasieu Chemical Corporation, which will use it to produce ethylene oxide and glycol in a plant adjacent to the ethylene unit. Lummus is currently designing and will build the Calcasieu installation.

Lummus has over half a century of experience with chemical and petrochemical projects. Why not discuss your next project with a Lummus representative.

THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, N. Y. *Engineering and Sales Offices and Subsidiaries:* New York, Houston, Montreal, London, Paris, The Hague, Bombay. *Sales Offices:* Chicago, Caracas. *Heat Exchanger Plant:* Honesdale, Pa. *Engineering Center:* Newark, N. J.

Lummus engineer points out cracking heaters in model of Petroleum Chemicals, Inc. ethylene plant.



—Photograph courtesy of Standard Oil Company (N. J.)

How much can preheat raise throughput?

Today's soaring production costs spotlight the need for increasing throughput . . . that is, if slim profit margins are to be kept from disappearing altogether. A look at the Ljungstrom Air Preheater will show how this can be done.

Ljungstrom efficiency comes from the fact that preheated air mixes more thoroughly with fuel. This assures more complete combustion . . . higher flame temperature . . . and increased heat absorption into the tubes – which raises still throughput by as much as 25%!

For example, an eastern refinery went from 16,000 barrels to 18/20,000 barrels a day when the pipe still was modernized with a Ljungstrom system. In addition, temperature control was much closer. The octane rating of the product, because of this fine control, was held to narrower limits – *with the average rating as much as two octane numbers higher.*

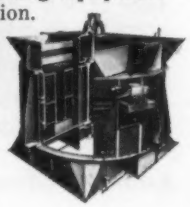
How fast is "WRITE OFF"?

In earnings from increased output and improved quality, many refineries write off the cost of the Ljungstrom in less than 2 years. These costs can be written off sooner, in fact, when you add other Ljungstrom advantages: savings up to 20% in fuel costs . . . higher throughput . . . less slag . . . and use of fuels you used to discard.

For more complete data on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits obtainable in fuel burning equipment – call or write the Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

Who's Building...

plant was slated to supply the basic raw material for the Brea-Koppers plant.

Initial capacity of the polyethylene plant was to have been 30 million pounds annually with an ultimate capacity planned at 60 million pounds. Union's ethylene plant would produce 10 million pounds of ethylene a year, more than enough to take care of the raw material needs of the Brea-Koppers facility.

El Paso Natural Gas Co. took another step towards becoming a major refiner by announcing that its subsidiary, El Paso Natural Gas Products Co. will soon start construction on a 6500-bpd refinery and alkylation plant at Odessa. The site will be close to the butadiene and styrene plants the firm is now building.

Plant facilities will include crude, vacuum, catalytic cracking, gas concentration, Platforming, and HF alkylation units. Contracts have been let to Universal Oil Products Co. for process design and to Fish Engineering Co. for engineering and procurement of major equipment. The plant is slated for completion in early 1958.

When the Odessa plant is complete, El Paso will have gone in just a little more than two years from a non-refiner to a company with five refineries and a daily capacity of 22,500 barrels.

Davidson Chemical Co. has placed on stream its new $1.5 million reforming catalyst plant at Curtis Bay, near Baltimore. The plant capacity is double that which was originally designed due to the rising demand for catalyst by U.S. refiners. Output of the platinum on alumina catalyst began on a partial basis last summer.

Carbide Chemicals Co., a division of Union Carbide Canada, Ltd., will double the polyethylene and ethylene glycol capacities originally planned for its Montreal East plant. The Canadian unit, which was started early in 1955, is scheduled to go on stream some time this spring.

Another Union Carbide subsidiary, Visking, Ltd., will build a $500,000 polyethylene film-making plant at Fort Gary, Winnipeg, Man.

Phillips Petroleum Co.'s. 16,000 bpd Platformer has gone on stream at its Kansas City, Kan., refinery. Designed by Universal Oil Products Co., it is the third UOP Platforming unit erected for Phillips by Procon Inc.

Borden Co. has opened its second formaldehyde plant on the West Coast. Capacity of this plant which is located at Kent, Wash., is 36 million pounds per year, and therefore makes Borden the largest producer in the area. Its other plant is at Springfield, Ore.

The Kent plant will be the first to use Borden's Karl Fischer process. The company expects a 93 percent formaldehyde yield as compared with a national average of from 82 to 88 percent.

The opening of the Kent plant raises Borden's total of chemical plants both domestic and foreign to 25.

National Iranian Oil Co. is planning to expand its facilities to transmit, refine, and market production from the Naft-I-Shah Oilfield on the Iraq border. An expansion of its Kermanshah refinery to quadruple its capacity to about 17,000

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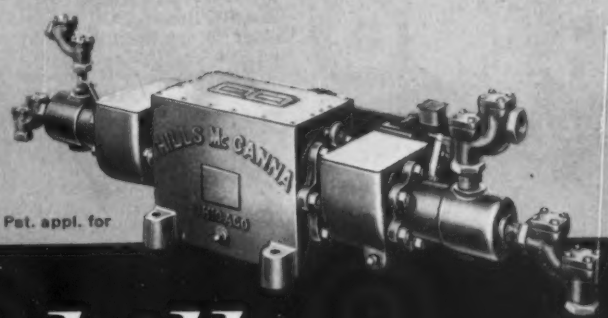

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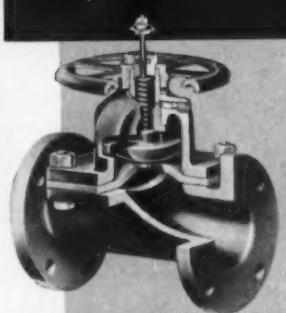

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Who's Building...

bpd will be underway shortly as material is currently being shipped. Costain-John Brown Ltd., London, England, has been retained as consultant for the project.

E. I. du Pont de Nemours and Co., Inc., has announced that the planned expansion of production facilities for Urea-ammoniating solutions at the company's Belle works in West Virginia is expected to be completed in 1959.

The plant's extensive high pressure synthesis facilities are gradually being converted to use natural gas instead of coal as a basic raw material.

In conjunction with plant modernization, the company is expanding its research in the development of new ammoniating formulations. The many technical services now available to customers also are being extended both at the Polychemicals sales service laboratory near Wilmington, and in the field.

Ethyl Corp. has begun preparation of the site at Pittsburg, Calif. for a West Coast plant to manufacture "Ethyl" antiknock compounds.

The new plant is expected to be completed by the middle of 1958. Actual construction of the plant is scheduled to begin soon. C. F. Braun & Co., Alhambra, Calif., will do the engineering for the plant.

Ethyl's Pittsburg plant will bring to four the number of plants in the United States and Canada for the production of "Ethyl" antiknock compounds, and will mark the third to be built since 1952.

Ethyl's new plant will be located on a site adjoining the Dow Chemical Co. and will be convenient to rail and water transportation. Principal features of the plant will include a central process building for the manufacture of antiknock compounds, shops-and-stores building, a steam generating plant, an administration building, and storage facilities.

The Fluor Corporation, Ltd., has been awarded a contract to perform construction work only on a new 16,000-bpd, low end point catalytic reforming unit, plus desulfurization facilities, for the Phillips Petroleum Co., at its Sweeny, Texas, refinery, about 75 miles south of Houston.

Construction is to begin July 1, with completion set for next January.

National Bulk Carriers has started initial work near Colon, Republic of Panama, on the site of what will be the first oil refinery in the entire Central American and Panama area. When completed in an estimated two years, it will cost about $33 million according to officials.

It will be owned and operated by the National Bulk Carriers, one of the world's largest oil tanker operators.

A second refinery is also planned near Colon by an investment group headed by John Shaheen of New York and Eugene Dupont 3rd. It will involve an investment in the neighborhood of $30 million, it is stated by officials.

While the site for the second refinery has not as yet been selected, it will be near the Atlantic coast port at the end of the Panama Canal. The investment group has obtained a favorable contract with the government of Panama and has deposited

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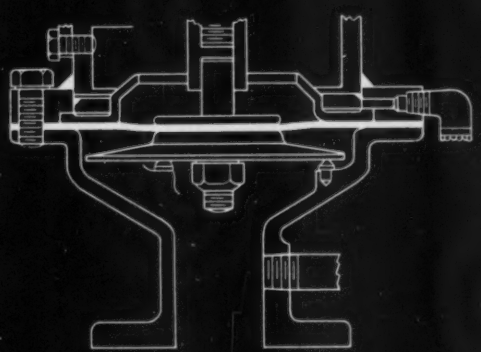
Protecting pressure storage vessels against the hazards incident to tank rupture due to excessive internal pressures is the purpose of S. & J. Pilot Operated Relief Valves, which are made in two models. The Model ST-5000 is applicable to vessels operating at pressures ranging from 1 to 15 pounds; and Model ST-2500 applicable to vessels with pressure ranges exceeding 15 pounds.

These pressure relief valves have Safety Features not found in other types of venting equipment—they are FRICTIONLESS in operation, with no bearings or sliding guides. No lubrication is required. They have considerable reserve force, and they operate at the exact pressures at which set, giving high venting capacity for their sizes.

The most important consideration is a patented safety feature* built into the pilot valve. Since there is always a remote possibility that the diaphragm in such a valve may rupture from fatigue, the piston of the pilot valve is so proportioned that tank pressure operating against it will cause the valve to open at a pressure below the regular setting.



* PATENTED SAFETY FEATURE
The effective area of the piston being greater than that of the diaphragm would cause the valve to vent at less than the "set" pressure, even if the diaphragm were entirely removed.

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MORE continuous processing results from the many features of Allis-Chalmers deep-rib, chemical-type motors in a variety of refinery and pipeline uses.

Here are only a few of the reasons why these motors "pay off" in petroleum applications:

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Rib construction is available in Allis-Chalmers motors from 1 to 100 hp. As a new machinery component or as replacement, specify Allis-Chalmers. Contact your A-C district office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.

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Who's Building...

$700,000 with the government as evidence of good faith, according to the group's lawyers.

Officials state that crude oil will be imported from Colombia and Venezuela, refined and re-exported to American and world markets. As yet, no commercial petroleum deposits have been located in Central America or Panama although extensive exploration work by major oil companies is currently under way.

Standard-Vacuum Oil Co. will expand and improve the output of its Durban, Union of South Africa, refinery during the next two years in a $9 million construction program.

An increase in throughput of Persian Gulf crude from 20,000 to approximately 25,000 bpd is planned by Standard-Vacuum Refining Co., of South Africa, Proprietary, Ltd.

Foster Wheeler Corp., of New York has been selected as the general contractor for erection of two major new units and minor additions of equipment. New construction includes a Powerformer for high octane gasoline manufacture; a Hydrofiner for power kerosene and automotive diesel oils, which are very important to meet expanding requirements in the Union of South Africa; and several other units including a steam plant and cooling facilities.

Foster Wheeler, primary contractors for the original refinery which went on stream in January 1954, will begin new construction later this year. Engineering design work is now in progress in Durban and the U.S.A.

Petroleo Brasileiro S.A. has decided on a site at Caxias, near Rio for its long-planned 90,000-bpd refinery. It is felt by company officials that the site is large enough to also accommodate possible future petrochemical facilities such as were installed in conjunction with the Cubatao refinery at Santos.

According to the governor of Rio state, construction is scheduled to start around the first week in September. As of yet, however, no information has been given as to who the contractor will be.

Petrobras claims that it has enough capital to finance the job, and will under no circumstances, accept financing offers from foreign oil companies. The plant is expected to cost between $50 million and $60 million.

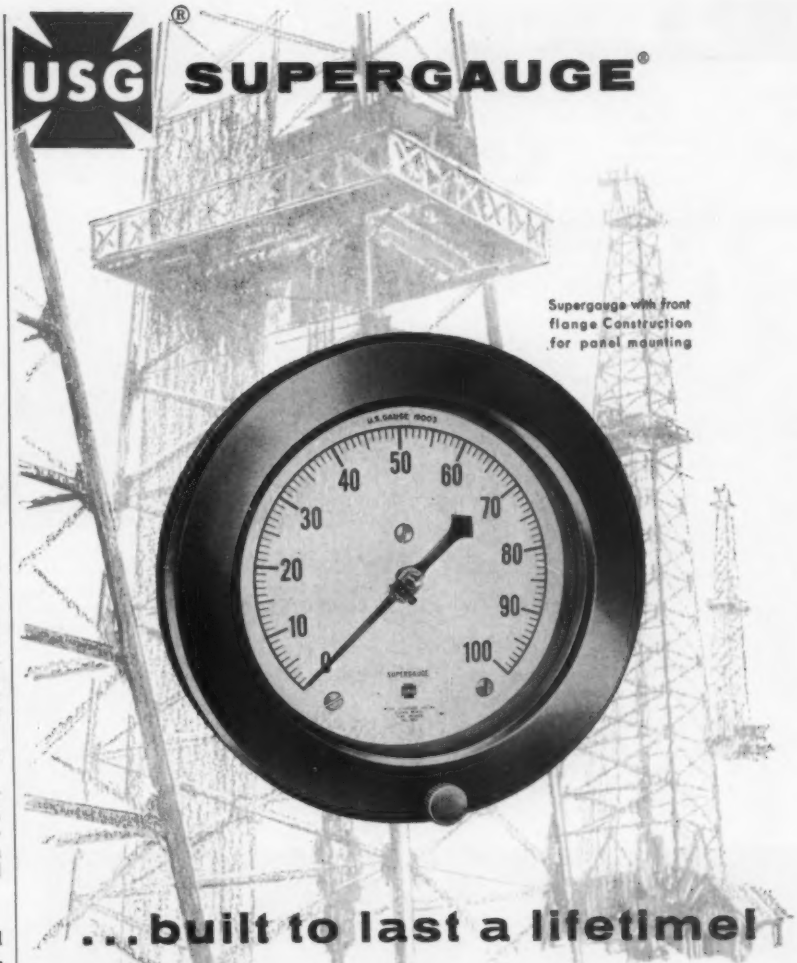
Royal Dutch/Shell Group plans to build by itself, or in conjunction with others, refineries in Ireland, Germany, Turkey, Japan and possibly one or two other countries. No further details were given.

Standard Oil Co. of California, Western Operations, Inc., will construct multi-million dollar catalytic reformer plants at its Richmond and Bakersfield refineries.

Designed to increase output of the higher octane gasolines Standard is now marketing, the two plants are expected to be ready for operation by mid-1958.

The Richmond project will be patterned after twin catalytic reformers the company built at its Richmond and El Segundo re-

USG® SUPERGAUGE®



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HERE'S WHY:

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Who's Building...

fineries two years ago. The Bakersfield plant will be somewhat smaller.

Both developments are part of Standard's over-all plan to increase the quality of its premium and regular grade gasolines.

Amoco Chemicals Corp. will start engineering and construction immediately on a chemical manufacturing plant near Joliet, Ill. The plant will use a new hydrocarbon oxidation process.

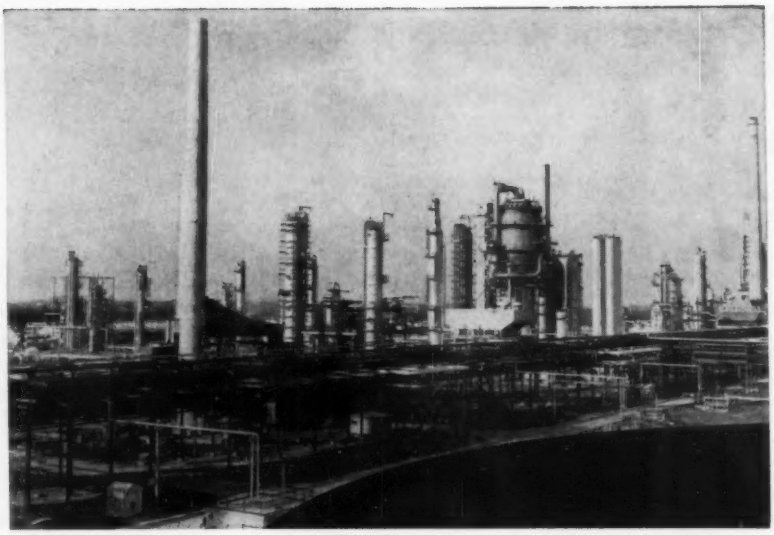
The new plant will be built on a site of about 400 acres four miles southwest of Joliet on the Des Plaines river. The plant is expected to be operating in 1958.

The site was selected because of available water, proximity to raw material, to markets for the products, and good transportation, Mr. Forrester said.

The plant, with a capacity of about 60 million pounds annually, will make phthalic anhydride, isophthalic acid, terephthalic acid, dimethyl terephthalate, dimethyl isophthalate, and benzoic acid. The raw material, mixed xylenes, will be obtained from the Standard Oil Co., (Indiana) refinery at Whiting, Ind.

The hydrocarbon process enables the production of a diversified line of chemicals at a single plant from one source, using petroleum raw materials. Standard Oil Co., parent of Amoco Chemicals, holds world-wide exclusive rights to the process.

The manager of the plant, previously announced, will be C. L. Parris who has been chief engineer at the El Dorado, Ark., refinery of the American Oil Co.



Shaping Up

Tidewater Oil Co.'s new 130,000-bpd Delaware refinery will soon be fully "on stream." This view of the main process area shows, from the left: the alkylation unit, the polymerization unit, the gas plant, fluid catalytic cracker, the crude unit, and the fluid coker.

Deutsche Shell plans to build a new refinery between Bonn and Cologne, Germany with an initial capacity of 60,000 bpd, and an eventual capacity of between 120,000 and 140,000 bpd. The company is presently expanding its Hamburg refinery by 40,000 bpd. This expansion program is expected to be completed by 1958.

United Refining Co.'s current expansion program was somewhat delayed by the steel strike, and therefore the new fluid catalytic cracking and polymerization facilities will not be placed on stream until March. The construction job, which was contracted to Procon, Inc., includes a 4000 bpd cat cracker, and a catalytic poly unit which will produce 225 bpd of finished polymer gasoline. Both processes are licensed by Universal Oil Products Co.

The Fluor Corp., Ltd., will begin field construction work next October on a sulfuric acid-alkylation unit and related offsite facilities at Shell Oil Co.'s refinery at Anacortes, Wash.

This will be the first major addition to the refinery since it went on stream in late 1955. The new unit, which will produce 2400 bpd of alkylate for aviation gasoline blending is scheduled for completion in mid-1958.

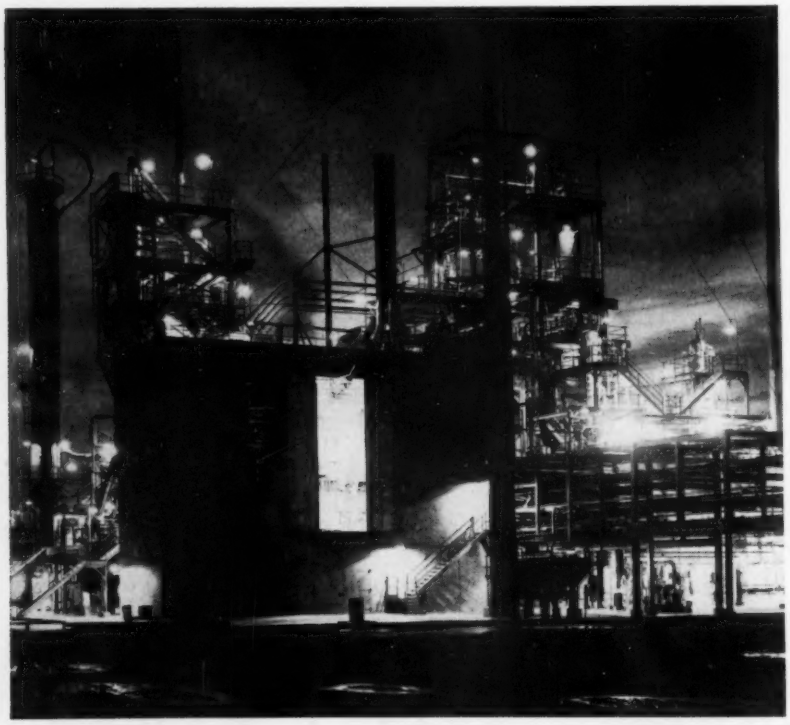
Cal-Mex Oil and Refining Co. will build a 20,000 bpd refinery with supporting facilities in San Diego County. According to George A. Kessler, director of western hemisphere operations for the parent company of Cal-Mex, three sites are under consideration.

Principal products of the refinery will be 100 octane gasoline, heating and bunker C fuel, and jet fuel. Plans for the refinery include crude, catalytic cracking, catalytic desulfurization, catalytic reforming, amine, catalytic polymerization, and sulfur recovery units.

The newest, most modern equipment to prevent release of pollutants to the air will be installed throughout the refinery at a cost of several million dollars.

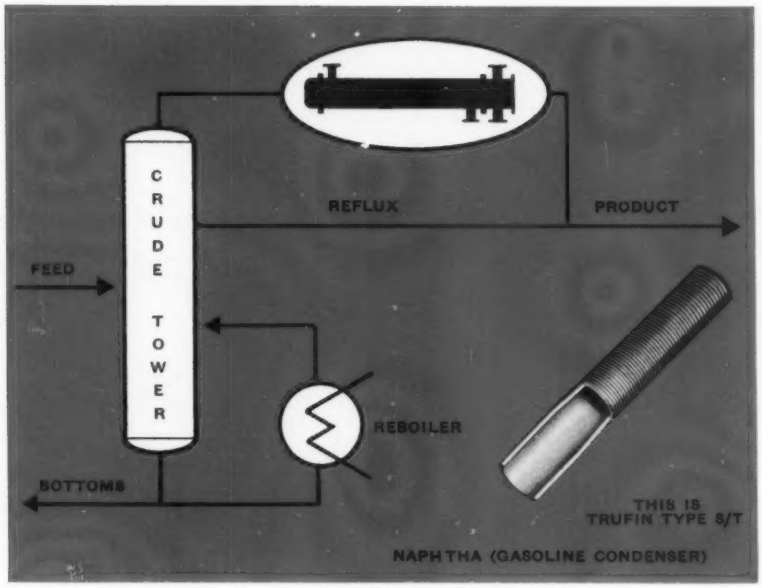
A contract for design, procurement, and construction of the plant has been awarded to The Ralph M. Parsons Co., Engineers-Constructors of Los Angeles. Parsons plans to have the plant on stream early in 1959.

Crude is to be imported and at first will be pumped from offshore into the refinery by pipelines. Later, tankers may use South San Diego Bay, provided the harbor is dredged to a sufficient depth.



24 Hour Operation

Shown is a portion of Du Pont's multimillion dollar tetraethyl lead plant which has just gone on stream at Antioch, Calif. Tetraethyl lead will be shipped from the plant to refiners west of the Rockies. The new operation employs a continuous process of manufacture, one which is more efficient than the old batch process. Construction was started in August of 1955.



WOLVERINE TRUFIN® NAPHTHA CONDENSER ON STREAM FIVE YEARS WITHOUT MECHANICAL CLEANING OF SHELL SIDE

BY ERNEST DODD

Five years of continuous operation, without even a single shutdown for mechanical cleaning on the shell side, is the outstanding record compiled by a naphtha condenser tubed with Wolverine Trufin® Type S/T —the integrally finned condenser tube.

THROUGHPUT UP 70%

Equally impressive is the fact that during this five year period, this Trufin-tubed unit has maintained throughput at a level 70% higher than the former condenser tubed with prime surface tube. In addition, this fine performance was achieved the hard way—under fouling and corrosive conditions regarded, by the processing engineers in charge, as the toughest in the entire refinery. The latest visual inspection showed that the shell side of the bundle was still not in need of mechanical cleaning. When the unit was formerly tubed with prime surface tube it was either cleaned or retubed every year.

The condenser tubed with prime surface tube required 10,916 lineal feet of tube to give a total heat transfer surface area of 2,145 square feet. When Trufin Type S/T was substituted for the plain tube, 10,916 lineal feet of finned tube was also required—but heat transfer surface jumped to 5,420 square feet—*a thumping 152% increase!* In its prime surface form the condenser transferred 5,491,000 BTU's per hour. But when retubed with Trufin heat duty zoomed to 9,340,000 BTU's per hour!

MORE OF SAME ORDERED

Needless to say the processing engineers at this large, Midwest refinery are delighted with Trufin's performance. They are, in fact, so pleased that five additional Trufin units are being installed in other refineries belonging to this company. Three of these will be used in naphtha condensing.

GET THIS BOOK—FREE

The Wolverine Process Flowsheet Book contains both text and illustrations describing actual installations where Wolverine Trufin Type S/T has been successfully used. This book can add to your finned tube information—should be in your files. Write, today!

HOW TO WRITE BETTER HEAT EXCHANGE "SPECS"

By making specifications as complete as possible, engineers can help insure that heat exchange equipment will meet their complete requirements. The following check list can help in writing better specifications:

Fluid—

- Total flow (including percentage of vapor and liquid)
- Analysis (Composition of fluid, or distillation curve and percentage of non-condensibles)
- Specific gravity (or A.P.I.)
- Specific heat at inlet, outlet and average temperature.
- Thermal conductivity at inlet, outlet and average temperature.
- Viscosity at inlet, outlet and average temperature.
- Quality—corrosion and fouling characteristics or fouling factor.
- Molecular weight of vapor.
- Latent heat of vapor; Temperature in—Temperature out; The steam ratio; Steam condensed; Operating pressure; Allowable pressure drop; Quantity of fluid vaporized or condensed.

State particular code requirements or standards which must be met. If own company has standards, supply copy to designer.

In setting allowable pressure drops give as much freedom as the process will allow—it will save you money!

Always give fouling data in terms of fouling factors—never specify as a per cent of clean service.

To be sure of the finest of quality controlled tubing always specify Wolverine condenser tube—in either prime surface or finned (Wolverine Trufin) form.

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How Can We Get Help On *Tubing Problems?*

Pictured on this page are seven Wolverine Technical Sales Representatives—who, because of their specialized training can supply the answer to the above question.

In addition to their own engineering backgrounds, they have completed an intensive study of tubing and heat transfer at Wolverine Tube. As a result, they are completely familiar with heat transfer problems dealing with the use of plain and finned condenser tube, corrosion, design and other related subjects.

They are also backed by Wolverine's entire engineering and research facilities. To help solve your problems they can recommend condenser tubing from Wolverine's product line-up — one of the most complete in the entire tubing industry.

Providing the products and trained personnel necessary to help you successfully conduct your business is the reason Wolverine Tube is in business. If you have a problem call on the Wolverine Technical Sales Representative nearest you. For more information about Wolverine products write for your copy of Wolverine's Condenser Tube Catalog. Either way you are under no obligation.

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Wolverine prime surface condenser tube is rigidly quality controlled — from raw material to finished product. It is available in a wide range of sizes and alloys in copper and aluminum.

DUPLEX PRIME SURFACE TUBE

Here's a tube designed to handle two types of corrosion at the same time. It consists of an outer tube of one metal and an inner liner of another. The combination can be any two alloys you need to meet special corrosive conditions.

TRUFIN TYPE S/T

An integral finned condenser tube Trufin Type S/T steps up heat transfer performance—extracts more BTU's per foot of tube. Type S/T is available in a wide range of sizes and alloys in copper, aluminum and electric-welded steel.

DUPLEX TYPE S/T

This condenser tube is designed with a double function in mind. Because it has an inner liner of a different alloy than the outer tube it withstands corrosive attacks on both sides. Because its outer tube is integrally finned (like Trufin Type S/T) it, too, transfers more BTU's per foot of tube.

U-BEND PALLETS

This unique Wolverine idea cuts time, reduces storage problems and saves money. U-bend condenser tubes — either finned or prime surface—are arranged in a disposable-box-type pallet in the exact order you specify. All you have to do is feed them directly from pallet to unit.

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario

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PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA.
SALES OFFICES IN PRINCIPAL CITIES.
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Construction Booms Along West Coast

Three new refineries and general beefing-up programs reported to 'Construction BOXSCORE'

New construction projects reported to PETROLEUM REFINER's exclusive "Construction BOXSCORE" since it was last published in January have recorded a continuation of the building boom which has recently developed along the West Coast of the United States.

During this short three month span, companies have announced plans for the construction of three new refineries. Two of these are scheduled for Washington's Puget Sound area while the third is slated for somewhere in San Diego County.

In addition, at those refineries and plants which are already operating, refiners are beefing-up existing units and adding new ones at a rapidly increasing rate.

Why the West?

An expanding market, particularly in California; the availability and proximity of crude oil from Canada; and the ease of transportation of refined products have accounted for the emphasis of construction in the West, and particularly in the Puget Sound area.

California's expanding market is of course increasing proportionately with its phenomenal growth. The population in California which was about 10 million in 1955 is expected to soar to more than 24 million by 1975. Naturally this growth will present a number of problems, one of the foremost being the fantastic amounts of energy requirements needed to feed the hungry industries and to satisfy the population.

Availability of Canadian crude which has risen year after year has conveniently ferreted out the Puget Sound area as a natural outlet. Using the Canadian crude to replace that which at one time was supplied by California has not affected California because of the tremendous population gains in that state.

Ease of transportation is another factor which may be attributed to Puget Sound's refining boom. The Juan de Fuca Strait which runs between Vancouver Island and Washington is a natural link between the Pacific Ocean and Puget Sound. Barges can easily be loaded and then can use these waterways to reach West Coast ports.

The "Construction BOXSCORE" appearing below has been an exclusive presentation of Petroleum Refiner for the past 10 years. It represents a continuing check on the world wide building program of the Refining-Processing Industry. If any reader knows of any projects which are not listed, or sees any which need correcting, please send such information to Petroleum Refiner, BOXSCORE Editor, P. O. Box 2608, Houston 1, Texas, U.S.A.

What's Ahead?

With the general migration of the population to the West, the oil and gas industry has been required to don its seven-league boots in order to stay up with the demand. This is particularly true with respect to natural gas.

With natural gas capacity and potential increasing, this area has opened the door for a major petrochemical expansion. Already under construction or on the drawing board are more than a dozen petrochemical plants led by such projects as a formaldehyde plant by Borden at Kent, Wash.; tetraethyl lead plants by Du Pont at Antioch, Calif., and by Ethyl Corp. at San Francisco; a butadiene plant and a copolymer plant by Shell Chemical at Torrance; three sulfuric acid plants in California by Stauffer Chemical; and a formaldehyde plant in Tacoma and a plasticizers plant in San Francisco by Reichold Chemicals. Two other projects, a polyethylene plant by Brea-Koppers at Los Angeles, and an ethylene plant by Union Oil in Los Angeles have been shelved pending the findings of an economic evaluation.

A healthy demand coupled with a ready source of crude oil and natural gas form a solid foundation for the growing construction on the West Coast. We can see nothing ahead but continued progress for this area.

Construction BOXSCORE

REFINERIES, NATURAL GASOLINE AND PETROCHEMICAL PLANTS

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
EAST									
Air Reduction Chemical	Calvert City, Ky.	Methyl, Butynol Plt.	3,000,000 lbs./yr.	.....	Engineering	Late 1957	.....	.....	.....
Allied Chemical Dye..	Elizabeth, N.J.	Sulfuric Acid	.....	.....	Planning	.....	.....	.....	.....
	Frankford, Pa.	*Naphthalene Purification Plt.	.....	.....	Under Constr.	Late, 1957	.....	Badger Mfg.	Badger Mfg.
American Cyanamid..	Northern Florida	Acrylic Fiber	27,000,000 bbls/yr.	.....	Planning	1958	.....	.....	.....
American Oil Co.....	Yorktown, Va.	Crude Distillation for Asphalt	25,000 bbls.	.....	.....	Early 1956	.....	.....	.....
		*Gas Treating Sulphur Recovery	50 tons	.....	Engineering	Nov., 1957	.....	Fluor	Fluor
American Synthetic Rubber	Louisville, Ky.	Exp. Copolymer Plt.	To 68,000 tons/yr.	$3,000,000	Under Constr.	1st. Qtr. 1957	.....	Kidde	Kidde

* First appearance in tabulation

Construction BOXSCORE Continued on Page 239

This SWECO-built refinery addition helped an Indiana plant pull from behind to a front position in the race to upgrade gasoline.

High Octane Package Handled with Care

Like many refineries, the Mt. Vernon plant of the Indiana Farm Bureau Association was caught with its rating down when the latest high octane race started. That was before SWECO wrapped up a $1,500,000 refinery package that included a 3,000 BPSD platformer, a 2,100 BPSD unifiner, and a new steam generating plant with an hourly capacity of 120,000 lb. of high-pressure steam.

Off and running

The platformer-unifiner team went on stream in November, 1956, and has been in continuous operation ever since. This combination unit, built under license from Universal Oil Products Company, makes Mt. Vernon a front runner in today's race to upgrade gasoline.

In planning the steam generating plant, SWECO engineers decided to save time by specifying the equipment and letting bids for fabrication. But outsiders couldn't meet the cost estimates or contract, so SWECO built the pressure vessels in its Los Angeles plant. They were delivered three days ahead of schedule.

Problems in stride

Heavy spring washouts and a tight budget were just some of the problems the SWECO engineering and construction crews took in stride. Designing and building moderate-size refinery installations is their specialty.

This is the kind of service, the extra service SWECO clients in the process industries expect. Large or small, at home or abroad, it's the only kind they get . . . in the *engineering and construction* of refineries (SWECO *is licensed to build plants for practically all major refining processes),* chemical plants and ore beneficiating mills . . . in the design and manufacture of *process equipment* such as heat exchangers, steam jet ejectors and distillation columns . . . in a full line of *vibrating screen separators.*

Write today for our new brochure on how SWECO products and services can help meet your processing needs. Ask for brochure E-2-333.

SWECO

Southwestern Engineering Company

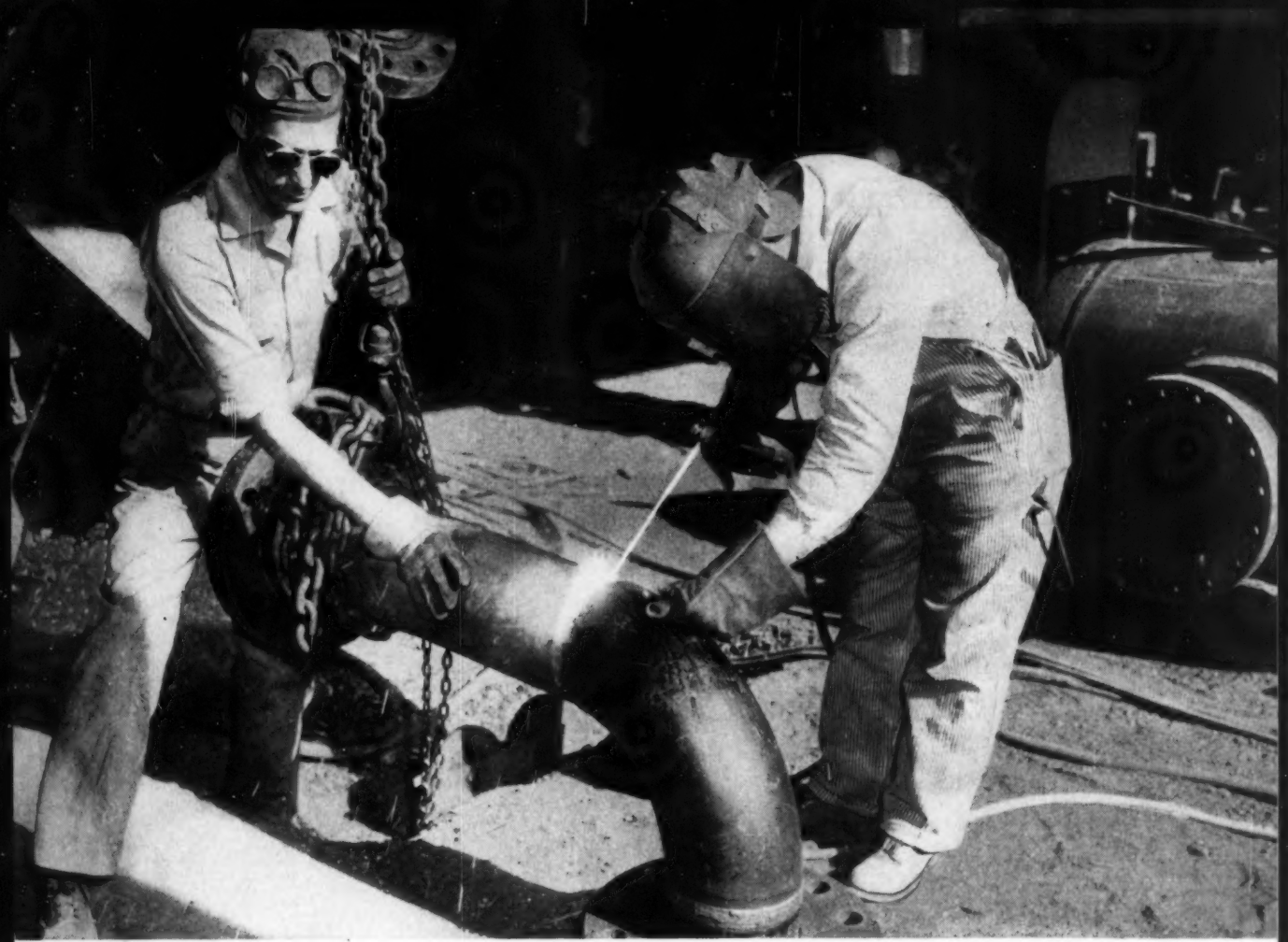
4800 Santa Fe Ave., Los Angeles 58, Calif.

CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Ashland Refining	Ashland, Ky.	Lube Oil Compounding Bldg.		$175,000		June, 1957			
	Buffalo, N.Y.	*Aromatics	45,000 gals.						
Atlantic Refining	Philadelphia	Unifiner-Catformer; Inc. Ammonia Cap.	15,000 bbls. †75 tons	Part of $11,500,000 Program	Engineering Engineering	Mid 1957	Atlantic	Blaw Knox	Blaw Knox
Cary Chemicals	Flemington, N.J.	PVC Resin Plt.			Under Constr.				
Cities Service	Linden, N.J.	*Refinery Modernization			Planning	1958			
	East Chicago	*Inc. Reforming Cap.			Planning				
Clark Oil & Refining	Blue Island, Ill.	*Cat. Cracker	16,000 bbls.		Engineering	March, 1958	UOP	UOP	Procon
Commerce Oil Ref.	Portsmouth, R.I.	Refinery, Cat. Cracking Crude Units	30,000 bbls. 25,000 bbls. 40,000 bbls.	$30,000,000	Planning	1957		Lummus	
Delta Refining Co.	Memphis, Tenn.	Girbotol Unit	1,500 bbls.		Under Constr.	Early, 1957		Girdler	Girdler
Dow	Allen Points, Conn.	*Styron Exp.			Under Constr.				
du Pont	Belle Works, W. Va.	*Urea; Ammonia			Planned	1959			
Escambia Chemical	Pensacola, Fla.	Methanol	18,000,000 gal./yr.		Engineering	March, 1958		Chemico; Badger Mfg.	
Esso Standard	Everett, Mass.	Powerformer	7,200 bbls.		Under Constr.	Mid 1957	Esso	Badger	Badger
	Linden, N.J.	Ethylene Plt.			Under Constr.			S&W Badger Div.	S&W Badger Div.
		*Alkylation	5,300 bbls.		Under Constr.				Parsons
	Bayway	*Hydrofiner	1,500 bbls.					Foster Wheeler	Foster Wheeler
		Powerformer	20,000 bbls.		Under Constr.	Mid 1957	Esso	Foster Wheeler	Foster Wheeler
Frontier Refinery	Fort Pierce, Fla.	Refinery	15,000 bbls.	$16,000,000	Planning		U.O.P.	Ebasco	
Frontier Refining	Buffalo, New York	Aromatics Plts.	45,000 gal.	$2,500,000 and $1,250,000 off-site facilities	Engineering	Early 1958	UOP	UOP	Procon
General Aniline & Film	Linden, N.J.	Ethylene Oxide: Ethylene Glycol		$8,000,000	Under Constr.	1957	SDC	SDC	SDC
Goodrich Chemical Co.	Calvert City, Ky.	Acrylic Polymers		$2,500,000	Under Constr.	Late, 1957			Wigton-Abbitt
Goodrich-Gulf	Institute, W. Va.	Boiler House		$1,500,000	Planning				
Gulf Oil	Philadelphia	Cat. Reforming	24,000 bbls.		Engineering	Late 1957	UOP	Procon	Procon
		Alkylation	2,800 bbls.		Under Constr.	2nd Qtr. 1957		Parsons	Parsons
		Gulfining	36,000 bbls.		Under Constr.	Early, 1957	Gulf	Gulf, Kellogg	Kellogg
	Near Charleston, S.C.	Refinery			Considering				
Hercules Powder	Parlin, N.J.	Polyethylene	30,000,000 lbs./yr.	$10,000,000	Under Constr.				
Heyden-Newport Chemical	Fords, N.J.	Pentaerythritol	25,000,000 lbs./yr.		Under Constr.	March, 1957		Staff	
Kendall Refining	Bradford, Pa.	*Unifiner	2,000 bbls.	$300,000	Under Constr.	2nd Qtr., 1957	UOP	UOP	Staff
Kentucky Hydrocarbon	Maytown, Ky.	Ethane Plt.	50 Mmcf.		Designing	Early 1957			
		*Gasoline Plt.	50 Mmcfd	$8,715,000	Under Constr.	2nd Qtr., 1957		Carbide & Carbon	C. H. Jimison & Sons
Koppers	Woodbridge, N.J.	Polyethylene	30,000,000 lbs./yr.		Under Constr.	Early 1957	Koppers	Koppers	Koppers
	Kobuta, Pa.	Polystyrene			Under Constr.	Early, 1958		Staff	Staff
Louisville Ref.	Louisville	*Platformer	2,000 bbls.	$1,000,000	Complete		UOP	UOP	Pritchard
Metal Hydrides	Danvers, Mass.	Hydrogen Plt.			Engineering			Girdler	Girdler
Paragon Oil Co.	Tiverton, R.I.	Refinery	30,000 bbls.	$35,000,000	Planning				
Pennsalt	Calvert City, Ky.	Organic-Fluorine			Planning				
Pontiac Eastern Corp.	Hattiesburg, Miss.	Refinery	12,000 bbls.	$18,000,000	Under Constr.	May, 1957	U.O.P.	Fluor	Fluor
Reichhold Chemical	Tuscaloosa, Ala.	Sulfuric Acid Plt.	100 tons/day	$1,000,000	Complete				
Rhode Island Ref.	Tiverton, R.I.				Planning				
Sinclair Refining	Marcus Hook, Pa.	*Gasoline Fractionation	10,000 bbls.		Engineering	Early, 1958		Fluor	Fluor
Socony Mobil	Paulsboro, N.J.	Hydrodesulfurisation	22,000 bbls.		Under Constr.	July, 1957		Foster Wheeler	Foster Wheeler
	Buffalo, N.Y.	Alkylation	2,440 bbls.		Engineering	Sept., 1957		Kellogg	Kellogg
Spencer Chemical	Henderson, Ky.	Polycarprolactum (Nylon) Plt.			Under Constr.	Summer, 1957	A.K.U., Arnhem	Staff	Quaker
Stauffer Chemical	Louisville, Ky.	Carbon Tetrachloride, Chloroform, Methylene Chloride, Hydrogen Chloride			Under Constr.	1957			
The Southland Co.	Black Point, Fla.	Refinery	15,000 bbls.	$12,000,000	Postponed				
Sunset International Petroleum	Torrance	*Thermal Heater	4,000 bbls.	$250,000	Under Constr.		UOP	UOP	Southern Eng. Constr. Co.
Thompson Chem.	North Dighton, Mass.	Polyvinyl Chloride Plt.			Planning		SDC	SDC	
Tidewater Oil	Wilmington, Del.	Refinery	130,000 bbls.	$100,000,000	Under Constr.	1957		Braun, Kellogg	
United Refining	Warren, Pa.	FCC Gas Recovery; Cat Poly; Treating	2,500 bbls.	$2,000,000	Under Constr.	April, 1957	UOP	UOP	Procon
MID-CONTINENT									
Amoco Chemical Corp.	Joliet, Ill.	Phthalic Anhydride Isophthalic Acid, Terephthalic Acid, Diemthyl Terephthalate, Dimethyl Isophthalate Benzoic Acid	60,000,000 lbs./yr.	$10,000,000	Engineering	1958			
Anderson-Prichard	Cyril, Okla.	Cat. Crkr, Fractionation; Light-Ends Recovery; Revamping	5,000 bbls.		Under Constr.	March, 1957	UOP	Procon	Procon
	Oklahoma City	Propane Desasphalting Unit	3,000 bbls.		Under Constr.	Late, 1957	Esso	Badger Mfg.	Badger Mfg.
Ashland Refining	Canton, Ohio	Cat Reformer Hydrogen Treater Vacuum Tower	6,000 bbls. 15,000 bbls.	$2,400,000 $1,200,000	Under Constr. Engineering	June, 1957 Oct., 1957		Blaw-Knox Blaw-Knox	Blaw Knox Blaw-Knox
Aurora Gasoline Co.	Detroit, Mich.	Fluid Coker	4,000 bbls.		Under Constr.		Esso	Parsons	Parsons
	Muskegon, Mich.	Vac. Cap.	6,000 bbls.		Under Constr.	March, 1957			

* First appearance in tabulation † Added capacity

Construction BOXSCORE Continued on Page 241



When Specs Demand Job Matched Piping and Fittings One Call Will Do it All—B&W

The layout has been made. Erection schedules are in the planning stage. What you do now in contacting a source of supply for your alloy steel pipe fittings and flanges, can very well be one of your most important moves.

If you call on B&W, you can be assured of benefits that simplify scheduling problems. With one call to B&W—on one order—you can obtain matched pipe, fittings and flanges to meet your specific requirements. What's more—the delivery of the alloy steel pipe, the seamless welding fittings, and the forged steel flanges that make up the integrated system you desire—can be coordinated. This is just one more reason why B&W has earned the reputation and acceptance as "the natural source" for alloy pipe and fittings.

Call on Mr. Tubes at your nearby B&W Tubular Products Division District Sales Office—let him coordinate your alloy steel pipe, seamless welding fittings and forged steel flange problems. He can help you. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA-7009-PP3

Seamless and welded tubular products, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steel.

CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Ben Franklin Refining	Ardmore, Okla.	*HF Alkylation	1,000 bbls.	.....	Engineering	Late, 1957	UOP	.....	.....
Century Refining.....	Garden City, Kans.	Cat Reformer	500 bbls.	$150,000	Engineering	1957	UOP	Litwin	Staff
Cities Service.....	Ponca City, Okla.	Rexformer	6,000 bbls.	.....	Complete	.....	UOP	UOP	Procon
		Increase Ref.	10,000 bbls.	$2,000,000	Engineering	May, 1957	UOP	UOP	.....
Clark Oil & Ref.....	Chicago	Refinery Expansion	9,000 bbls.	$5,000,000	.....	.....	.....	.....	.....
		Vacuum Unit	.....	.....	.....	.....	.....	UOP	CBI; Morrison
		Crude Heater	.....	.....	Complete	1958	.....	.....	Morrison
		Alkylation	.....	.....	.....	March, 1958	UOP	.....	.....
		Gas Recovery	.....	.....	.....	March, 1958	UOP	UOP; Procon	Procon
		Cat Cracker	.....	.....	.....	March, 1958	UOP	UOP; Procon	Procon
	Blue Island, Ill.	*Alkylation Plt.	16,000 bbls.	.....	Engineering	Late, 1957	UOP	UOP	.....
Coastal Chemical.....	Pascagoula, Miss.	*Fertilizer Plt.	300 tons	$5,000,000	Engineering	Dec., 1957	St. Gobain Union Chimique Beige	Fluor	Fluor
Commercial Solvents & Columbus Gas	Ohio Valley	Petrochemical Plt.	.....	$40,000,000	Planning	.....	.....	.....	.....
Commercial Solvents..	Terre Haute, Ind.	*Plant Expansion	.....	$2,000,000	Under Constr.	August, 1957	.....	Staff	Local
Continental Oil.....	Ponca City	Cat Reformer	11,000 bbls.	$3,000,000	Under Constr.	Mid 1957	.....	Kellogg	Kellogg
		Feed Treating							
		*Cat Reformer.	11,000 bbls.	$3,000,000	Under Constr.	Mid, 1957	.....	Kellogg	Kellogg
		Desulphurizer	16,000 bbls.						
	Short Junction, Okla.	*Natural Gaso. Plt.	60 Mmscfd	$1,750,000	Under Constr.	June, 1957	.....	.....	Tuloma
Cooperative Refinery Asso.	Phillipsburg, Kans.	*Unifiner	3,500 bbls.	$1,500,000	Planned	Early, 1958	UOP	UOP	.....
		*Platformer	2,500 bbls.						
Derby Refining.....	Wichita, Kans.	Exp. Ultraformer	4,000 bbls.	$600,000	Completing	.....	Standard-Ind.	.....	Pritchard
Dow Chemical.....	Bay City, Mich.	Ethylene Plt.	.....	.....	Engineering	Jan., 1958	.....	.....	.....
D-X Sunray.....	Duncan, Okla.	Unifining	6,000 bbls.		Under Constr.	Later 1957	UOP	Treco	Treco
	Tulsa	Platformer	12,000 bbls.						
		Unifining	20,000 bbls.	$10,000,000					
		HF Alkylation	2,500 bbls.		Under Constr.	Late 1957	UOP	Treco	Treco
		Butane-isomerization	.....						
Ethyl Corp.....	Joliet, Ill.	*Antiknock Compounds	.....	.....	Planned	.....	.....	.....	.....
Firestone Tire	Akron, Ohio	Expand Syn. Rubber Plt.	40,000 tons	.....	Complete	.....	.....	.....	.....
Goodrich Chemical...	Avon Lake, Ohio	Add. Polyvinyl Resins, Plastic Compounds	.....	$8,000,000	Under Constr.	March, 1957	.....	Girdler	Girdler
Goodyear Synthetic Rubber	Akron, Ohio	Copolymer Exp.	27,000 tons/yr.	$2,500,000	Under Constr.	June, 1957	.....	Staff	Carmichael
Hawthorne Chemical Co.	Louisiana, Mo.	Methyl, Methacyrlate Plt.	35,000,000 lbs./yr.	$11,000,000	Engineering	.....	.....	.....	.....
Hercules Powder.....	Louisiana, Mo.	Formaldehyde Plt.	100,000,000 lbs./yr.	.....	Under Constr.	1957	.....	.....	.....
		Pentaerythritol Plt.	24,000,000 lbs./yr.	.....	Under Constr.	1957	.....	.....	.....
		Methanol Plt.	7,000,000 gal./yr.	$2,000,000	Under Constr.	Mid 1957	Vulcan	Vulcan	Vulcan
		Hydrofiner	5,200 bbls.	.....	Under Constr.	.....	Std. (N.J.)	Pritchard	Pritchard
Kerr McGee.....	Wynnewood, Okla.	*Platformer	5,500 bbls.	.....	Planned	.....	.....	.....	.....
		*Unifiner	4,000 bbls.	.....	Planned	.....	.....	.....	.....
Lion Oil Co.....	El Dorado, Ark.	Nitric Acid Concentrator	40 tons	.....	Under Constr.	Early 1957	.....	.....	C&I
Monsanto Chemical...	Monsanto, Ill.	*Phenol Plt. Exp.	25 percent	.....	.....	.....	.....	.....	.....
Naph-Sol Refining Co.	Muskegon, Mich.	Cat. Reformer	6,000 bbls.	.....	Planned	.....	.....	.....	.....
National Petro-Chemicals	Tuscola, Ill.	*Exp. Polyethylene Plt.	100,000,000 lbs./yr.	$10,000,000	Under Constr.	Mid, 1957	I.C.I.	Kellogg, Staff	Kellogg
Northwestern Ref. Co.	St. Paul Park, Minn.	Cat. Reformer	6000	$2,500,000	Planning	Jan., 1958	.....	.....	.....
Olin Mathieson.....	Olin, Ind.	Cellophane Plt.	.....	.....	.....	.....	.....	.....	.....
	Mapleton, Ill.	*Antifreeze Plt.	.....	$1,500,000	Under Constr.	Spring, 1958	.....	.....	P. S. Edwards Company
Pan-Am Southern Corp.	El Dorado, Ark.	Ultraformer	6,200 bbl.	.....	Under Constr.	July, 1957	Standard, Indiana	Lummus	Lummus
Pana Refining Co.....	Pana, Ill.	Modernization	†1,600 bbls.	$900,000	.....	.....	.....	.....	.....
Petroleum Specialties	Flat Rock, Mich.	Visbreaker	3,000 bbls.	$250,000	Planning	.....	.....	Litwin	.....
Prime Oil Co.....	Calumet City, Ill.	Refinery	15,000 bbls.	$10,000,000	Planned	.....	.....	.....	.....
Procter & Gamble....	Kansas City, Kans.	Hydrogen Plt.	.....	.....	Engineering	1957	.....	Girdler	Girdler
The Pure Oil Co.....	Lemont, Ill.	Cat. Reformer	12,000 bbls.	.....	Under Constr.	Fall, 1957	.....	Kellogg	Kellogg
		Feed Prep. Unit	17,000 bbls.	.....	.....	.....	.....	.....	.....
Reichhold Chemicals..	Tuscaloosa	*Formaldehyde Plt.	35,000,000 lbs./yr.	.....	Planning	1957	Staff	Staff	Staff
	Detroit	*Formaldehyde Plt.	35,000,000 lbs./yr.	.....	Planning	1957	Staff	Staff	Staff
Rock Island Refining	Indianapolis	*Inc. Unifining Cap.	4,600 bbls.	.....	Under Constr.	Aug., 1957	UOP	UOP	Staff
		*Inc. Platforming	2,800 bbls.	.....	Engineering	Aug., 1957	UOP	UOP	Staff
Sinclair Refining.....	East Chicago	Hydrofinishing	.....	$1,300,000	Under Constr.	.....	.....	Treco	Treco
		*MEK Deoiling	1,000 bbls.	.....	Planning	Spring, 1958	.....	.....	.....
		*Gaso. Fractionation	18,000 bbls.	.....	Engineering	Early, 1958	.....	Fluor	Fluor
	Wood River, Ill.	Cat. Reformer	7,500 bbls.	$7,000,000	Under Constr.	July, 1957	.....	McKee	McKee
Skelly Oil Co.....	El Dorado, Ark.	*HF Alkylation	3,000 to 4,000 bbls.	.....	Planned	Early, 1958	Phillips	Staff	Staff
	Medicine Lodge, Kans.	*Exp. Natural Gaso. Plt.	40,000 gals.	.....	Engineering	Jan., 1958	.....	Skelly	.....
Socony Mobil.....	East St. Louis	Sovaformer	12,000 bbls.	.....	Planning	1957	.....	Fluor	Fluor
		Pretreater	16,000 bbls.	.....	Planning	1957	.....	Fluor	Fluor
	Augusta, Kans.	Cat. Reformer	9,000 bbls.	.....	Under Constr.	Aug., 1957	.....	Pritchard	Pritchard
	Trenton, Mich.	Alkylation Unit	3,500 bbls.	$3,500,000	Engineering	Early, 1958	.....	Fluor	Fluor
Standard-Indiana.....	Wood River, Ill.	Coking Unit	8,500 bbls.	.....	Planning	1957	.....	.....	.....
	Sugar Creek, Mo.	Alkylation	3,800 bbls.	.....	Under Constr.	Mid. 1957	.....	Foster Wheeler	Foster Wheeler
	Whiting, Ind.	Ultraformer	21,000 bbls.	.....	Under Constr.	Early, 1957	Std (Ind.)	Parsons	Parsons
		Rehabilitation	.....	.....	Complete	.....	.....	.....	.....
		Ultraformer II	21,000 bbls.	.....	Engineering	1958	Std. (Ind.)	McKee	McKee
	Neodesha, Kans.	Ultraformer	6,000 bbls.	.....	Engineering	Early 1958	Std. (Ind.)	Foster Wheeler	Foster Wheeler
Standard (Ohio).....	Toledo, Ohio	Refinery Exp.	†60,000 bbls.	$40,000,000	Under Constr.	Mid. 1958	.....	Kellogg	Kellogg
	Elmore, Okla.	Exp. Gasoline Plt.	†2k Mmcf	.....	Under Constr.	.....	.....	.....	.....
	Cleveland, Ohio	Alkylation	3,000 bbl.	$3,000,000	Planning	Early 1958	.....	.....	McKee Co.
St. Paul Ammonia Products	Pine Bend, Minn.	*Ammonia Plt.	200 tons	$16,000,000	Under Constr.	June, 1957	Texaco	Lummus	Lummus
Sunray Mid-Continent Oil	Near Carnex, Okla.	Gaso. Products Field Plt.	17¼ million cu. ft.	.....	Engineering	.....	.....	.....	Tuloma
The Texas Co.....	Lawrenceville, Ill.	Inc. FCC Cap.	2,000 bbls.	.....	Under Constr.	.....	.....	.....	.....
	Lockport, Ill.	Platformer	10,000 bbls.	.....	Under Constr.	4th Qtr., 1957	.....	UOP	Staff
		Convert Hydroformer							
		Ammonia Plt.	180 tons	.....	Under Constr.	4th Qtr., 1957	.....	Foster Wheeler, C&I	Foster Wheeler, C&I

* First appearance in tabulation † Added capacity

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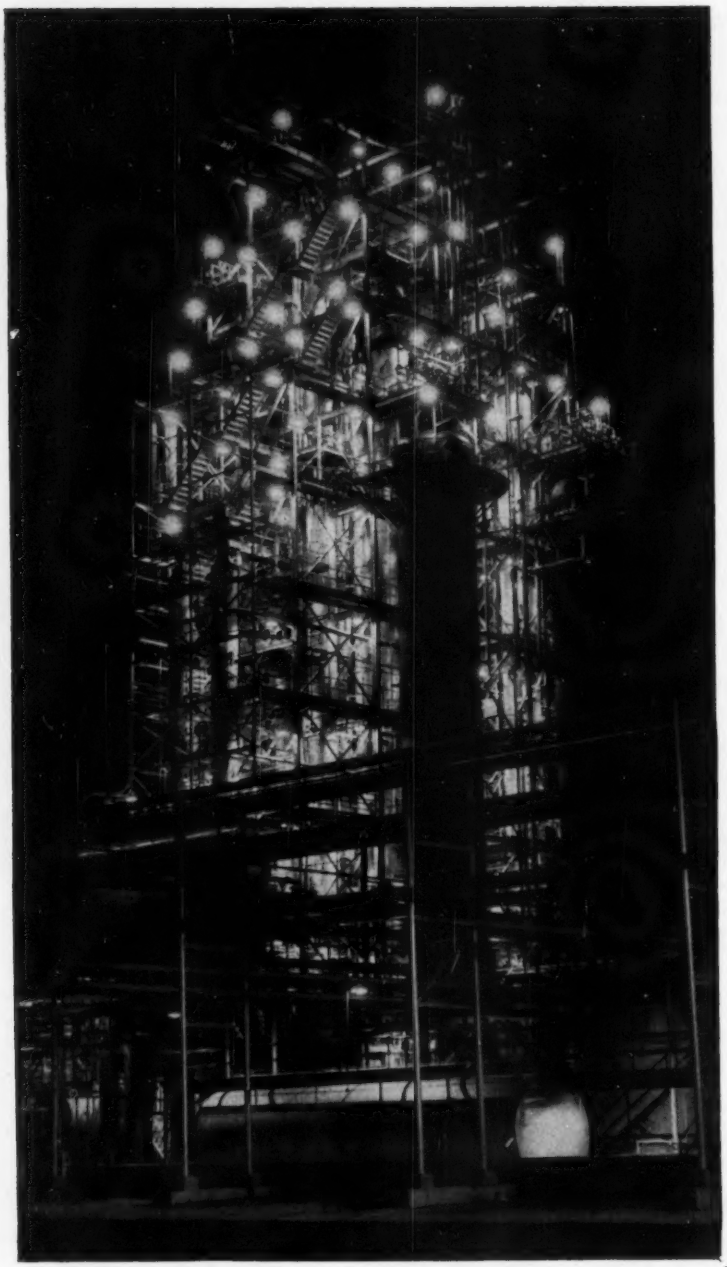


Night and Day... Year after Year

durable Unibestos insulates vital piping

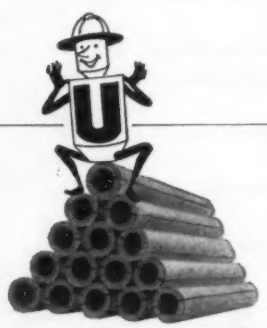
Pipe insulation shouldn't perform just part of the time. Any time heat escapes, efficiency drops...costs go up. Vital piping requires the kind of continuous protection that single-layer Unibestos insulation provides.

Unibestos is made with Amosite, the quality, long-fiber asbestos with superior insulating properties. Built strong to stay strong, Unibestos resists vibration and shock...withstands steam, acid, and other chemical fumes.

Single-layer Unibestos makes installation simpler, too. It's easily cut, mitered or grooved to fit bends, expansion joints —in fact, all fittings. Unibestos® pipe insulation is available in sectional form through 44" O.D.

UNARCO

UNION ASBESTOS & RUBBER COMPANY
1111 West Perry Street
Bloomington, Illinois



Joe Bestos says:

Why does UNARCO make more high-temperature pipe insulations than anyone else? Because UNIBESTOS **single-layer** construction is unmatched for ease of installation . . . because it heat-seals joints and fittings, too . . . because it stands up under shock and vibration. It's durable, reliable, made up to 44" O.D.

For more data on advertised products, use Readers' Service Cards, last page.

CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
U. S. I. C.	Tuscola, Ill.	Isomer of Sebacic Acid	10,000,000 lb./yr.		Under Constr.	July, 1957			
Vickers Petroleum	Potwin, Kans.	Ultraformer	3,500 bbls.	$1,000,000	Engineering	June, 1957	Std.-Ind.	Parsons	Parsons
		*Udex Unit	15,000,000 gals./yr.	$2,000,000	Under Constr.	Jan., 1958	UOP	Procon	Procon
Westland Oil Co.	Williston, N.D.	Inc. Platformer	530 bbls.	$260,000	Under Constr.	Sept., 1957	UOP	UOP	Staff
		*Therm Cracker	1,000 bbls.	$300,000	Under Constr.	June, 1957		UOP	Pet. Pipe Cont.
Wisconsin Oil Refining Co.	Sheboygan, Wis.	Vacuum Unit	2,500 bbls.		Planning			Koch	
SOUTHWEST									
Aluminum Co. of America	Point Comfort, Texas	Gas Processing Plt.	100 MMSCFD	$1,500,000	Under Constr.	Spring, 1957		Pregle, Dukler & Crump	Staff
American Cyanamid	Avondale, La.	Acrylonitrile PH		$25,000,000	Under Constr.	1958			
American Oil	Texas City	Ultraformer & Desulfurization Unit	21,000 bbls.		Engineering	Early 1958		Parsons	Parsons
Atlantic Refining	Pt. Arthur, Texas	Unifiner-Catformer	15,000 bbls.	Part of $11,500,000 Program	Engineering	Mid 1957	Atlantic	Blaw-Knox	Blaw-Knox
		*Alkylation Unit	2,100 bbls.		Under Constr.	Spring, 1958			
	Crane, Texas	Gasoline Plt.	20.5 Mmcf		Engineering				
	Atreco, Texas	*Catformer	15,000 bbls.	$4,500,000	Under Constr.	July, 1957		Blaw-Knox	Blaw-Knox
Bureau-Mines	Excell, Texas	Helium Plt.		$6,000,000	Planning			Stearns-Rogers Bureau-Mines	
Calcasieu Chemical	Lake Charles	*Ethylene Oxide; *Ethylene Glycol	8,000,000 gals./yr.			Early, 1958	Shell		Lummus
Calumet Refining	Princeton, La.	*Distillation Unit	2,000 bbls.		Under Constr.	Aug., 1957		Kellogg, Staff	Staff
Carbide & Carbon	Seadrift, Texas	Ethylene Oxide Exp.	To 200,000,000 lbs./yr.		Planning				
		Inc. Ethylene Glycol Cap.	To 65,000,000 lbs./yr.		Planning				
Celanese	Houston	Polyolefin Refin.	40,000,000 lbs./yr.		Under Constr.	1957	Phillips	Braun	Braun
	Bishop, Texas	Plt. Expan.	25 Percent		Under Constr.	1957			
	Pampa, Texas	Acrylate Ester Plt.	15,000,000 lbs./yr.		Under Constr.	Late 1957			
Chemol Corp.	New Orleans	Refinery	20,000 bbls.	$20,000,000	Planning				
Cities Service, et al.	Midland, Texas	Nat. Gaso. Plt.	50 Mmcf		Under Constr.	March, 1957		Delta	Delta
Cities Service	Lake Charles, La.	*Inc. Reforming Cap.			Planning				
		*Ammonia Plt.	100,000 tons/yr.		Under Constr.	1957			
		*Ethylene Plt.	2,000,000 lbs./yr.						
	Dora Roberts Ranch, Texas	*Natural Gaso. Plt.			Under Constr.				
Commercial Solvents	Sterlington, La.	Methanol Ammonia Nitrate		$8,000,000	Under Constr.	July, 1957		Ford, Bacon, Davis; Staff	Ford, Bacon, Davis
Corpus Christi Refg.	Corpus Christi	Rexformer	15,000 bbls.		Under Constr.	Early 1957	UOP	Treco	Treco
Cosden Pet.	Big Spring, Texas	Modernization & Expansion	20,000,000 lbs./yr.	$3,000,000	Under Constr.	Feb., 1957		Badger Mfg.	Badger Mfg.
		Styrene Plt.	†3,000 bbls.	$1,200,000	Under Constr.				
Delhi-Taylor Oil	Corpus Christi	Unifining Platforming	14,000 bbls.		Under Constr.	Early 1957	UOP	Treco	Treco
		Udex Unit	4,500 bbls.		Under Constr.	Early 1957	UOP	Treco	Treco
Diamond Alkali	Houston	Perchlorethylene Exp.	50 percent		Under Constr.				
		Acetylene Plt.			Engineering				
		*Electrolytic Chlorine Caustic			Under Constr.			Staff, Hedrick	
	Deer Park	*Vinyl Chloride Plt.		$10,000,000	Engineering	Early, 1958		SDC	Brown & Root
Dorchester, Corp.	White Deer, Texas	Cat. Reformer	1,000 bbls.	$400,000	Under Constr.	June, 1957	Atlantic	Grebe & Doremus	Staff
Dow Chemical	Plaquemine, La.	Caustic Soda, Chlorine, Ethylene and Propylene Glycols and Oxides, Chlorinated Solvents		Part of $50,000,000	Under Constr.	1958			
	Freeport, Texas	Acetylene, Methylacetylene, Ethanolamines, Synthetic Glycerine, Butadiene, Chlorine, Ethylene Oxide, Methyl Chloride, Glycerine, Glycol, Perchloro EthyleneandStyrene		$45,000,000	Under Constr.	1958			
Du Pont	Orange	Exp. Polyethylene Fac.			Planning				
	Near New Orleans	*Petrochemical Plt.			Considering				
	Beaumont, Texas	*Chlorinated Polyethylene Plt.			Under Constr.	June, 1957		du Pont	du Pont
Eastern States Petroleum Co.	Houston	Coking Plt.	13,000 bbls.	$4,000,000	Projected				
El Paso Natural Gas Products	Odessa, Texas	Butadiene	137 tons	$20,000,000	Under Constr.	July, 1957	Houdry, Esso, Jasco	Fluor	Fluor
		*Styrene	95,800 lbs.	$5,000,000	Engineering	Jan., 1958	UOP	Fish	Fish
		*Refinery	6,500 bbls.		Engineering	Early, 1958			
	El Paso, Texas	Alkylation Blending			Planning				
Esso Standard	Baton Rouge	Ethylene, Butadiene Expan.; Wax, Lube Oil, Avgas		$40,000,000					
		*Powerformer	25,000 bbls.		Under Constr.				Bechtel
		*Alkylation	6,500 bbls.						
Ethyl Corp.	Baton Rouge	Vinyl-Chloride Monomer Pet.			Under Constr.	Late 1957		Cat. Constr.	Cat. Constr.
Firestone	Orange, Texas	Butadiene Plt.	40,000 tons/yr.		Engineering	April, 1957	Houdry, Esso	Cat. Constr.	Cat. Constr.
	Lake Charles, La.	Expand Synth. Rubber Plt.	190,000 ton/yr.			April, 1957			
General Petroleum	Lake Charles, La.	Anhydrous Ammonia	100,000 tons/yr.	$12,500,000	Engineering	Fall 1957			
General Tire	Odessa, Texas	Copolymer Plt.	40,000 tons/yr.	$8,000,000	Under Constr.	March, 1957		Aerojet-General	Aerojet-General
Goodyear Synthetic Rubber	Houston	Copolymer Expansion	216,000 tons/yr.	$10,000,000	Under Constr.	March, 1957		Blaw Knox	Tellepsen
Grace Chemical	Baton Rouge, La.	Polyethylene	50,000,000 lbs./yr.	$18,000,000	Under Constr.	Mid 1957	Phillips	Fluor	Fluor
Gulf Oil	Pt. Arthur, Texas	Inc. Ethylene Fac.			Considering				
		Polymerization Inc.	2,800 bbls.		Under Constr.	Summer, 1957		Gulf; Procon	Procon
		Greasemaking; Packaging			Under Constr.	Late 1957		Summer Sollitt	Summer Sollitt
		Sludge Decomposer	125 tons		Engineering	Early 1957	Monsanto; Sonneborn	Leonard	Leonard

* First appearance in tabulation † Added capacity

Construction BOXSCORE Continued on Page 245

Klingerit Gaskets

STOP

Costly Joint Failures

Klingerit Gaskets meet the rigid demands to today's high temperatures and pressures by practically eliminating *COSTLY* joint failures. Refineries and Chemical Plants alike have found that Klingerit Gaskets cost less, too! Cost less because they keep joints TIGHTER . . . LONGER, thus reducing high gasket maintenance. Available in thicknesses of ·008" to $\frac{1}{4}$"— sheet size to 60" × 160".

"Klingerit" — Universally used sheet packing for super-heated and saturated steam, hydraulic pressures, compressed air, gases, chemicals, oils, spirits and ammonia solvents.

"Klinger-Oilit" — Oil resistant sheet packing intended for use in oil refining and distributing as well as for use with methyl-chloride and sulphur dioxide.

"Klinger-Acidit" — Acid resisting sheet packing, produced especially to resist hot nitric, hydrochloric and sulphuric acids, as well as most other organic and inorganic acids.

"Klingerit 1000" — Wire reinforced sheet packing for extremely high pressures and temperatures. Specially suitable for cylinder head and exhaust joints in internal combustion engines, gas turbines, etc.

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GA 24/57

CONSTRUCTION BOXSCORE—*Continued*

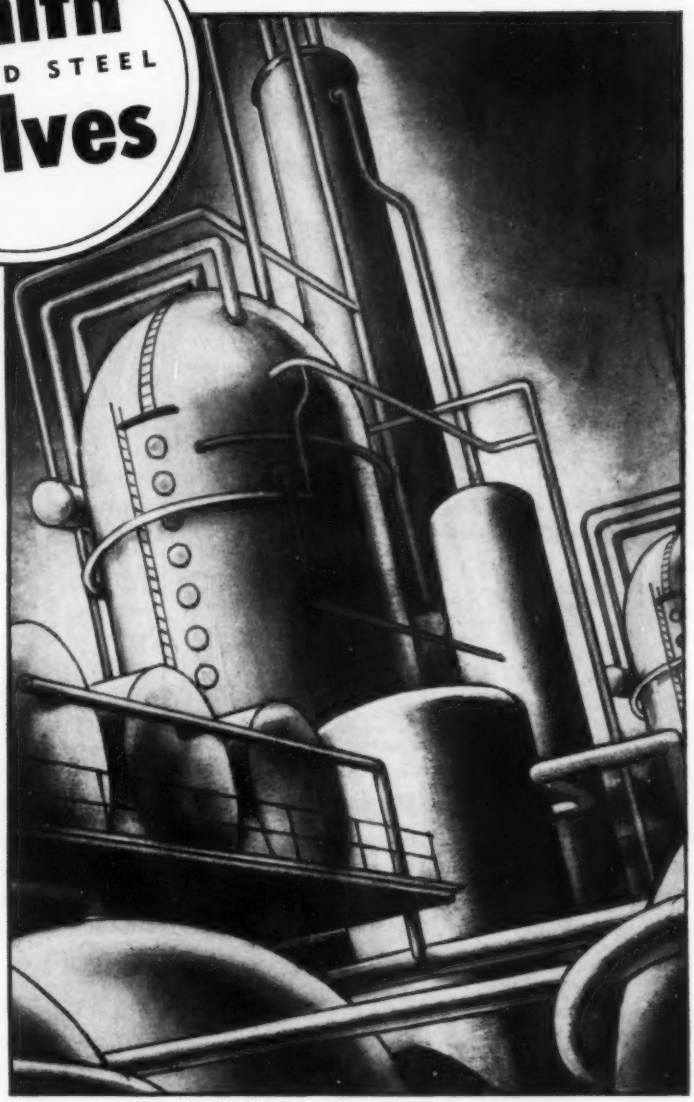
COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Gulf Oil (Cont'd).....	Pt. Arthur, Texas	Sulfur Recovery Inc.	60 tons	.....	Engineering	Early 1957	.....	Parsons	Parsons
		Platformer	26,000 bbls.	.....	Planning	Early 1958	UOP	Procon	Procon
J. M. Huber.....	Borger, Texas	Furnace Black	20-30,000,000 lbs./yr.	.....	Planning	.....	.....	.....	.....
Humble.....	Baytown, Texas	Inc. Butadiene Cap.	16,000 tons/yr.	.....	Under Constr.	Early 1957	.....	.....	.....
		FCC	55,000 bbls.	.....	Planning	.....	.....	Foster Wheeler	Foster Wheeler
		Benzene Plt.	1,500 bbls.	.....	Under Constr.	Jan., 1958	.....	Parsons	Parsons
		Ethylene Recovery Plt.	80,000,000 lbs./yr.	.....	Under Constr.	Mid. 1958	.....	.....	.....
Jefferson Chemical....	Port Neches, Texas	Inc. Ethylene, Double Ethylene, Glycol Cap. Inc. of Ethylene Oxide Cap.	.....	.....	.....	.....	.....	.....	.....
Kellogg.....	Houston	Polyolefins	.....	.....	Licensed	Phillips	.....	.....	.....
Lake Charles Chemical	Lake Charles, La.	Coking, Calcining Unit	10,000 bbls.	$6,250,000	Planning	Sept., 1957	.....	Fluor	Fluor
Magnolia.....	Beaumont, Texas	Crude Distil.	100,000 bbls.	.....	Engineering	Mid 1958	.....	.....	Foster Wheeler
		*Alkylation Unit	8,000 bbls.	.....	Engineering	Early 1958	.....	Staff, Braun	Braun
McBride Refining Co.	Port Brownsville, Texas	Ref. Expan.	†12,500 bbls.	$2,500,000	Planned	.....	.....	.....	.....
Merichem.....	Houston	Plant Expan.	.....	$1,000,000	Under Constr.	Sept., 1957	.....	Tears	Brown & Root
MidSouth Chemical..	Lake Charles, La.	Ammonia Plt.	.....	.....	Engineering Planning	.....	.....	.....	.....
Monsanto.....	Luling, La.	Adipic-Acid	.....	.....	Under Constr.	Early 1957	.....	.....	.....
Neches Butane Products	Port Neches, Texas	*Butadiene Plt. Exp.	300,000 tons/yr.	.....	Under Constr.	Mid, 1958	.....	Foster Wheeler	Foster Wheeler
Northeast Texas Chemical Co.....	East Texas	Chemical and Fertiliser Plt.	.....	.....	Planning	.....	.....	Tears	Beck
Odessa Butadiene....	Odessa, Texas	*Houdry Dehydrogenation	50,000 tons/yr.	.....	Under Constr.	July, 1957	Houdry	Fluor	Fluor
		*Esso CAA Purification	.....	.....	Under Constr.	July, 1957	Esso-Jasco	Fluor	Fluor
		*Styrene Plt.	35,000,000 lbs./yr.	$5,000,000	Engineering	Jan., 1958	.....	UOP	Fish
Panhandle Oil Corp..	Wichita Falls, Texas	Platformer	3000	$625,000	Engineering	June, 1957	U.O.P.	Tears	Tears
Petroleum Chemicals..	Lake Charles	Anhydrone Ammonia	100,000 tons/yr.	$12,500,000	Under Constr.	Fall 1957	.....	Foster Wheeler	Foster Wheeler
		Ethylene Plt.	19,000,000 lbs./yr.	.....	Under Constr.	Jan., 1958	.....	Lummus	Lummus
		*Butyl Rubber Plt.	30,000 tons/yr.	$17,000,000	Engineering	Early 1959	.....	Foster Wheeler	Foster Wheeler
Petro-Tex Chemical...	Houston	Butadiene Expansion	†45,000 tons/yr.	$1,000,000	Under Constr.	Early 1957	.....	Bechtel	Bechtel
Phillips Petroleum....	Sweeny, Texas	Nat. Gas Liquid Fractionation	30,000 bbls.	.....	Under Constr.	Early 1957	.....	S&W	S&W
		Inc. Alkylation	2,000 bbls.	.....	Under Constr.	March, 1957	.....	Phillips	Phillips
		Gas Cracking Facil.	8,200 bbls.	.....	Under Constr.	Spring, 1957	.....	S&W	S&W
		Pentane Factionation	15,000 bbls.	.....	Planning	Fall 1957	UOP	Phillips	.....
		Inc. Crude Capacity	10,000 bbls.	.....	Under Constr.	2nd Qtr, 1957	.....	Phillips	Phillips
		Inc. Cat. Reformer	2,000 bbls.	.....	Under Constr.	2nd Qtr., 1957	.....	Phillips	Phillips
		Inc. Nat. Gas Liq.	20,000 bbls.	.....	Planning	Fall, 1957	.....	Phillips	.....
		*Cat. Reformer; Desulfurization	16,000 bbls.	.....	Engineering	Jan., 1958	.....	Fluor	Fluor
	Houston	Polyethylene Plt.	110,000,000 lbs./yr.	.....	.....	.....	.....	.....	.....
Phillips Chemical.....	Gulf Coast	Carbon Black	64,000,000 lbs./yr.	.....	Planning	.....	.....	.....	.....
	Sweeny, Texas	Ethylene	794,500 lbs.	$12,357,000	Under Constr.	July, 1957	.....	Phillips; S&W	S&W
	Pasadena, Texas	Polyethylene	301,000 lbs.	$31,525,000	Under Constr.	August, 1957	.....	Phillips	Farnsworth & Chambers
	Phillips, Texas	Exp. Copolymer Plt.	138 tons	.....	Under Constr.	July, 1957	.....	Tellepsen; Phillips	Tellepsen
		Exp. Butadiene Cap.	104 tons	.....	Under Constr.	July, 1957	.....	Tellepsen; Phillips	Phillips
Premier Oil Ref. Co...	Longview, Texas	Cat. Poly. Plt.	.....	.....	Under Constr.	.....	.....	.....	.....
		Platformer, Unifiner Revamp Crude Topping Thermal Cracking Units	4,500 bbls.	$,250,000	Engineering Design	Early 1957	UOP	Procon	Procon
		Unifiner-Platformer	1,500 bbls.	.....	Under Constr.	April, 1957	.....	Procon	Procon
Rohm & Haas.....	Houston	Acetylene	.....	.....	Under Constr.	.....	.....	Chemico	Chemico
		Methanol	100 tons	.....	Engineering	1st Qtr., 1957	Texaco	Foster Wheeler	Foster Wheeler
Shell Chemical.....	Norco, La.	Methyl, Ethyl, Ketone, Hydrogen Peroxide; Offsite Facil.	.....	.....	Under Constr.	4th Qtr., 1957	.....	Braun, Fluor,	Braun, Fluor,
		Exp. Isopropyl Alcohol Facl.	.....	.....	Under Constr.	1958	.....	.....	.....
	Houston	Exp. Isopropyl Alcohol Facl.	20,000,000 lbs./yr.	.....	Under Constr.	1958	.....	.....	.....
Sinclair Refining.....	Corpus Christi	Revamp Crude Still	10,000 bbls.	$550,000	Under Constr.	April, 1957	.....	Tellepsen	Tellepsen
		*Cat. Reformer	6,500 bbls.	.....	Engineering	Spring, 1958	.....	Fluor	Fluor
	Houston	Hydrodesulphurisation	24,000 bbls.	$5,600,000	Under Constr.	Fall, 1957	.....	Parsons	Parsons
	Hulldale Field, Texas	*Desulfurizer	.....	.....	Under Constr.	.....	.....	.....	.....
Standard-Texas.....	El Paso	FCC	27,000 bbls.	$5,000,000	Planning	Sept., 1957	.....	Foster Wheeler	Foster Wheeler
		Ref. Exp.	†25,000 bbls.	.....	Under Constr.	4th Qtr. 1957	Esso	Staff, Fluor	Fluor
Suntide Refining.....	Corpus Christi	Unifiner	6000 bbls.	.....	Under Constr.	June, 1957	.....	UOP, Treco	Treco
		Rexformer	15,000 bbls.	.....	Under Constr.	June, 1957	UOP	UOP, Treco	Treco
		Udex Unit	4500 bbls.	.....	Under Constr.	Oct., 1957	.....	UOP, Treco	Treco
Texas City Refining...	TexasCity, Texas	Houdriformer.....	7,000 bbls.	$2,000,000	Under Constr.	Mid 1957	Houdry	Catalytic	Catalytic
Texas Eastman.....	Longview, Texas	Inc. Oxo Fac.	.....	.....	Planning	.....	.....	.....	.....
		Inc. Polyethylene Cap.	†20,000,000 lbs./yr.	.....	Planning	.....	.....	.....	.....
The Texas Co.....	Port Arthur	Power Plant	.....	.....	Under Constr.	4th Qtr., 1957	.....	Jackson & Moreland	Texaco
		Crude Unit	86,000 bbls.	.....	Under Constr.	2nd Qtr., 1958	.....	Fluor; Kellogg	Fluor; Kellogg
		Cat Cracker	60,000 bbls.	.....	Under Constr.	Early, 1958	.....	Fluor; Kellogg	Fluor; Kellogg
		Inc. Alkylation	2000 bbls.	.....	Under Constr.	2nd Qtr., 1958	.....	Fluor; Kellogg	Fluor; Kellogg
		Vacuum Pipe Still	80,000 bbls.	.....	Under Constr.	Late, 1957	.....	Fluor	Fluor
Union Oil & Gas et al.	Eunice, La.	Gasoline Plt.	300 Mmcf	.....	Under Constr.	Sept., 1957	.....	Fluor	Fluor
U. S. Rubber.....	Baton Rouge, La.	Petrochemicals	.....	$5,000,000	Under Constr.	Nov., 1957	.....	Walter Kidde	.....
Wyandotte Chemical.	Geismar, La.	Ethylene-Oxide Glycol	60,000,000 lbs./yr.	$8,000,000	Approved	Fall, 1957	Shell	Lummus	Lummus
		Electrolytic, Chlorine-Caustic Plt.	300 tons	$20,000,000	Approved	Late 1958	.....	Fluor	Fluor
ROCKY MOUNTAIN									
American Gilsonite...	Gilsonite, Colo.	Gasoline from Gilsonite	7000 bbls.	$10,000,000	Under Constr.	May, 1957	.....	.....	Foster, Wheeler Kaiser Eng.
		Hydrogen	550 Mmcf	.....	Engineering	.....	.....	Girdler	Ferguson

* First appearance in tabulation † Added capacity

Construction BOXSCORE Continued on Page 247

Smith FORGED STEEL Valves

150 lb. series
300 lb. "
600 lb. "
½" - 2" incl.

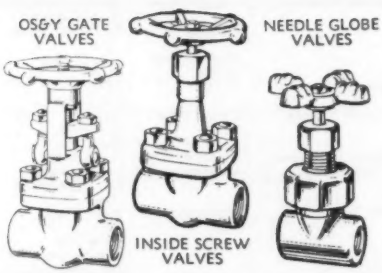


SMITH FLANGED END GATE VALVES

... for longer trouble-free life in service

Smith Flanged End Gate Valves, like all other Smith Valves, are designed, engineered and precision-built to meet the exacting needs of the Process Piping Industries.

A combination of special features designed and built into Smith Valves is your guarantee of longer, trouble-free life in service. They are manufactured according to the most rigid standards of accuracy, high quality of material, expert workmanship, and meet A.S.A. specifications and end to end dimensions. Write today for complete information and prices.



NEW ENGLAND VALVE Corporation

P. O. BOX 1047 • WORCESTER, MASSACHUSETTS

West Coast Distributors: BETHLEHEM SUPPLY CO., LOS ANGELES, CALIFORNIA

CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
American Gilsonite (Continued)	Grand Junction, Colo.	*Cat. Reformer	.....	.....	.....	Spring, 1957	.....	Ferguson	.....
		*Delayed Coker	4,000 bbls.	.....	.....	Spring, 1957	.....	Foster Wheeler	Foster Wheeler
		*Hydrogen Unit	.....	.....	.....	Spring, 1957	.....	Ferguson	.....
	Salt Lake City	*Metallurgical Coke and Gasoline	700 tons	.....	.....	Spring, 1957	.....	.....	.....
Apache Powder Co.	Curtiss, Ariz.	*Ammonia Synthesis Plt.	.....	$1,000,000	Engineering	Late 1957	.....	Girdler	Girdler
Atlantic Refining Co.	Lovington, N.M.	Natural Gas	25 Mmcf.	.....	Complete	.....	.....	.....	.....
Bay Petroleum	Denver	*Platformer	3,500 bbls.	.....	Planned	Early 1958	.....	.....	.....
Continental Oil Co.	Denver	Cat. Reformer	3,500 bbls.	$1,400,000	Engineering	Nov., 1957	.....	Staff, Treco	Treco
El Paso Natural Gas	Gallup, N.M.	Refinery; Alkylation, Cat Reforming, Cat. Cracking, Vacuum, Crude Unit	6,500 bbls.	$8,000,000	Under Constr.	Fall 1957	UOP	Sweco	Sweco
Empire Petroleum	Denver	Hydrosulfurization	1,000 bbls.	.....	Designing	Spring, 1957	British Petroleum	Litwin	.....
First National Petroleum Corp.	Jensen, Utah	Ref. Expan.	To 3,000 bbls.	.....	Planned	.....	.....	.....	.....
General Petroleum	Santa Fe Springs, N.M.	*Plant Exp.	24,000 Mcf	$100,000	Complete	.....	.....	.....	.....
Malco Refineries	Roswell, N.M.	HF Alkylation	900 bbls.	.....	Under Constr.	Mar., 1957	UOP	UOP	Grebe & Doermus
Phillips Petroleum	Great Falls, Mont.	Cat. Cracking	3,000 bbls.	.....	Under Constr.	Spring, 1957	.....	Procon	Procon
Salt Lake Refg.	Salt Lake City	Inc. Cap.	3,000 bbls.	.....	Under Constr.	.....	.....	.....	.....
		Reformer	6,000 bbls.	.....	Planning	Nov., 1957	.....	.....	Fluor
Socony Mobil	Casper, Wyo.	Cat. Reforming	3,000 bbls.	.....	Pre-engineering	Late, 1957	.....	Pritchard	Pritchard
		Cat. Hydrodesulfurization	3,250 bbls.	.....	Pre-engineering	Late, 1957	.....	Pritchard	Pritchard
Standard-Indiana	Casper, Wyo.	Lube Oil Plt.	5,000 bbls.	.....	Under Constr.	May, 1957	.....	Foster Wheeler	Foster Wheeler
		Vacuum Pipe Still	4,800 bbls.						
		Propane Deasphtg.	1,000 bbls.						
		Furfural Extraction	1,500 bbls.						
		MEK Dewaxing, Deoiling	2,000 bbls.						
Western States	North Salt Lake City	*Houdriformer	1,000 bbls.	.....	Under Constr.	.....	.....	.....	.....
WEST COAST									
Bankline Oil	Bakersfield, Calif.	*Desulfurizer Reformer	3,800 bbls.	$100,000	Under Constr.	Sept., 1957	Sinclair; Baker	Staff, Kellogg	.....
Brea-Koppers	Los Angeles	Polyethylene	60,000,000 lbs./yr.	.....	Postponed	.....	Koppers	Koppers	Koppers
Borden	Kent, Wash.	Formaldehyde	36,000,000 lbs./yr.	.....	Under Constr.	Late 1956	.....	.....	.....
Cal-Mex Oil & Refining	San Diego	*Refinery	20,000 bbls.	.....	Engineering	Early 1959	.....	Parsons	Parsons
Douglas Oil Co.	Los Angeles	Unifiner	.....	.....	Under Constr.	June, 1957	.....	.....	Macco
		Topping Plt.	12,000 bbls.	.....	Planned	.....	.....	.....	.....
Dow Chemical	Pittsburg, Calif.	Synthetic Latex	.....	$1,000,000	Complete	.....	.....	.....	.....
Du Pont	Antioch, Calif.	Fluorinated Hydrocarbons, Tetraethyl Lead	.....	.....	Under Constr.	.....	.....	.....	.....
Ethyl Corp.	San Francisco	Petrochemical Plt.	.....	.....	.....	.....	.....	.....	.....
Fletcher Oil	Wilmington, California	*Add Crude Units	.....	$125,000	Under Constr.	1957	.....	Staff	.....
General Petroleum	Ferndale, Wash.	Sovaformer	.....	.....	Engineering	Sept., 1957	Socony	Socony, Bechtel	Bechtel
	Torrance, Calif.	Exp. Gasoline Plt.	.....	.....	Under Constr.	.....	.....	.....	.....
		Sovaformer	12,000	$8,000,000	Engineering	Late, 1957	Socony	Socony, Bechtel	Parsons
Golden Bear Oil Co.	Bakersfield, Calif.	Inc. Crude Cap.	4,000 bbls.	$125,000	Complete	.....	.....	Staff	Oil Field Constr. Co.
	Oildale, Calif.	*Revamp Furfural Treating Unit	.....	$100,000	Under Constr.	1957	.....	Staff	.....
Hancock Oil	Signal Hill	*Fluid Coker	6,000 bbls.	$2,000,000	Project Abnd.	.....	.....	.....	.....
Phillips Pacific	Kennewick, Wash.	Ammonia Plt.	200 tons	$12,000,000	Under Constr.	Feb., 1957	.....	Fish-Phillips	Fish
Reichhold Chemicals	South San Francisco	*Plasticizers	.....	.....	Under Constr.	Late 1957	.....	Staff	Staff
	Tacoma, Wash.	*Formaldehyde Plt.	35,000,000 lbs./yr.	.....	Under Constr.	1957	Staff	Staff	Staff
Richfield Oil	Everett, Wash.	*Refinery	.....	.....	Engineering	.....	.....	.....	.....
Shell Chemical	Torrance, Calif.	Exp. Butadiene Plt.	.....	.....	Complete	.....	.....	.....	.....
		Mod. Copolymer Plt.	.....	.....	.....	.....	.....	.....	.....
	Dominquez Calif.	Exp. Isopropyl Alcohol Facl.	.....	.....	Under Constr.	1958	.....	.....	.....
Shell Oil	Dominquez,	Platformer	.....	.....	.....	.....	.....	Kaiser	Kaiser
	Anacortes, Wash.	*Alkylation Unit	.....	.....	Engineering	Mid 1958	.....	Fluor	Fluor
	Wilmington	*Boiler for Cat. Cracker	200,000 lbs.	$1,000,000	Under Constr.	.....	.....	.....	.....
Standard Oil (Calif.)	Honolulu	Refinery	20-30,000 bbls.	$25-30,000,000	Planned	1958	.....	.....	.....
	Everett, Wash.	Refinery	60,000 bbls.	$75,000,000	Planning	1959	.....	.....	.....
Stauffer Chemical	Dominquez, Calif.	Sulfuric-Acid Plt.	.....	$2,000,000	Under Constr.	Early 1957	.....	.....	.....
	Compton, Calif	Sulfuric Acid	.....	$57,070	Engineering	.....	.....	.....	.....
	Richmond, Calif.	Sulfuric Acid	.....	$283,500	.....	.....	.....	.....	.....
Straits Refining	Puget Sound	Refinery	8,000 bbls.	$26,430,000	ODM Approved	.....	.....	Tears	Tears
The Texas Co.	Anacortes, Wash.	Refinery	40,000 bbls.	.....	Under Constr.	Jan., 1959	.....	Bechtel	Bechtel
Tidewater	Associated, Calif.	Fluid Coker	42,000 bbls.	.....	Under Constr.	Early 1957	.....	Bechtel	Bechtel
		Hydrosulfurizer	24,000 bbls.	.....			.....	Bechtel	Bechtel
		Gas Plt.	.....	.....			.....	Bechtel	Bechtel
		Exp. Fluid Cat. Cracking	.....	.....			.....	Bechtel	Bechtel
		*Platinum Cat. Reformer	22,500 bbls.	.....	Under Constr.	March, 1958	.....	.....	.....
		*Steam Generating Plt.	.....	.....	.....	.....	.....	.....	.....
Union Oil	Los Angeles	Ethylene Plt.	100 million lbs./yr.	.....	Under Constr.	1st Qtr., 1958	Fluor	Braun	Braun
	Oleum, Calif.	*Crude Topping Plt.	.....	.....	Under Constr.	Summer, 1957	.....	E & A	E & A
U.S. Oil & Refining	Tacoma, Wash.	Refinery	15,000 lbs.	.....	Under Constr.	1957	UOP	J. B. Gill	J. B. Gill
		Cat. Reformer	2,700 bbls.	.....	.....	.....	.....	Holmes & Narver	Holmes & Narver
		*Houdriformer	2,500 bbls.	.....	Under Constr.	Summer, 1957	Houdry	Holmes & Narver	Holmes & Narver
Wilshire Oil	Norwalk, Calif.	Unifiner-Platformer	10,000 bbls.	.....	Under Constr.	Jan., 1957	UOP	Sweco	Sweco
OUTSIDE U.S.A.									
Canada									
Anglo-Canadian	Sarnia, Ont.	Ref. Exp.	30,000 bbls.	.....	Under Constr.	1957	.....	.....	.....
British American Oil	Clarkson, Ont.	Cat. Reforming	10,250 bbls.	$4,000,000	Under Constr.	June, 1957	Atlantic	Lummus	Lummus
		Desulfurization	12,000		Under Constr.	June, 1957	Atlantic	Lummus	Lummus
		Crude Exp.	40,000	$5,500,000	Under Constr.	Late 1957	.....	Kellogg	Kellogg
		*Offsite Facilities	.....	$4,000,000	Under Constr.	.....	.....	Fluor	Fluor

* First appearance in tabulation

Construction BOXSCORE Continued on Page 251

report of Cooper-Bessemer

Centrifugal Operation at Gulf Interstate...

Automation a Reality

in Gas Pipeline Transmission

Complete control — from 80 miles away — of an unattended main line compressor station ....

That's the story of Gulf Interstate's Stanton Station where their Cooper-Bessemer engine-driven centrifugal has now operated over 5500 hours. Here all operating functions such as starting, speed changing, shutting down and valving operations are automatically sequenced and under control of the remote operator.

Advantages of this new kind of set-up are many .... big savings in the cost of supervision, building and personnel housing .... centralized dispatching for improved system control and with fewer increments of control .... quicker adjustment to emergency and new operating conditions.

Cooper-Bessemer centrifugal compressors now meet a wide range of service requirements. Why not talk with the nearest Cooper-Bessemer office about your plans?

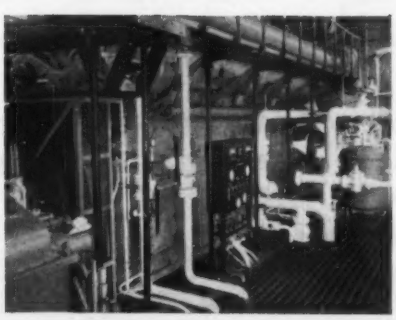
BRANCH OFFICES: Grove City • New York • Chicago
Washington • San Francisco • Los Angeles • Houston • Dallas
Odessa • Pampa • Greggton • Seattle • Tulsa • St. Louis
Kansas City • Minneapolis • New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Limited...
Edmonton • Calgary • Halifax.
Cooper-Bessemer International Corporation... New York
Chacao • Havana • Mexico City.

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO
ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

With 41% thermal efficiency, this Cooper-Bessemer 4-cycle engine is unsurpassed in fuel economy by any other type of prime mover.



In Gulf Interstate's satellite station near Stanton, Kentucky, this Cooper-Bessemer centrifugal compressor is driven by a 4-cycle Cooper-Bessemer engine operating economically on natural gas from the pipeline.

10-TON/DAY PACKAGE UREA PLANTS for FERTILIZER PRODUCERS

PROTECT YOUR NITROGEN PROFITS!
EXPAND YOUR SOLUTIONS SALES!

BASED ON **VULCAN-INVENTA PROCESS**
PROVEN **AGAIN** IN LARGE NEW
AMERICAN INSTALLATIONS

THIS SMALL PACKAGE PLANT IS **DESIGNED**
TO TAKE THE **RISK** OUT OF **YOUR** START IN **UREA!**

- High-Purity Urea Product Solution
- Quick Plant Completion
- Minimum Plant Investment
- Minimum Operating Costs
- Minimum Maintenance Costs
- Easy, Reliable Operation
- The Utmost in Once-Through Synthesis Simplicity

HERE IS YOUR OPPORTUNITY TO BENEFIT FROM VULCAN'S EXPERIENCE IN DESIGNING AND CONSTRUCTING LARGE AND SMALL UREA SYNTHESIS PLANTS.

VULCAN ENGINEERING DIVISION

VULCAN-Cincinnati, Inc. General Offices and Plant, CINCINNATI 2, OHIO
(Formerly THE VULCAN COPPER & SUPPLY CO.)
HOUSTON BOSTON CHARLOTTE, N. C. ST. LOUIS DENVER SAN FRANCISCO
VULCAN ENGINEERING DIVISION • VULCAN MANUFACTURING DIVISION • VULCAN CONSTRUCTION DIVISION

CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
British American Oil (Continued)	Montreal	Desulfurization	15,500	.....	Under Constr.	Mid 1957	.....	Lummus	Lummus
		CO Boiler	150,000 lbs.	$650,000	Under Constr.	Early 1957	Babcock-Wilcox	Babcock-Wilcox	Babcock-Wilcox
	Edmonton	*Cat. Reformer	4,000 bbls.	$1,500,000	Engineering	Early 1958	.....	Lummus	Lummus
		*Cat. Desulfurization	6,300 bbls.		Engineering	Early 1958	Atlantic	Lummus	Lummus
	Nevis, Alba.	Sulfur Recovery	225 tons	.....	Under Constr.	1957	.....	Parsons	Parsons
British Petroleum	Near Montreal	*Refinery	30,000 bbls.	$30,000,000	Planning	.....	.....	.....	.....
Canadian Hydrocarbons, Ltd.	Winnipeg, Man.	Fertilizer Plt.	600 tons	$18,500,000	Planning	.....	.....	.....	.....
Canadian Oil	Sarnia	Udex Unit-Reformer	3,650 bbls. 4,400 bbls.	$3,000,000	Under Constr.	About Aug., 1957	UOP	UOP, Staff	Fluor
	Corunna	*Platformer; *Udex	4,400 bbls. 3,650 bbls.	$3,000,000	Under Constr.	Aug., 1957	UOP	UOP; Fluor	Fluor
Canadian Petrofina	Montreal	Increase Cap.	.....	.....	Planning	.....	.....	.....	.....
Cities Service	Toronto	New Refinery	20,000 bbls.	$22,000,000	Engineering	.....	.....	Braun, Ltd.	Braun, Ltd.
Dow of Canada	Sarnia	*Exp. Ethylene Plt.	.....	$4,000,000	Under Constr.	Fall, 1957	.....	Staff	Canadian; Bechtel; Stearns-Rogers
Du Pont	Maitland, Ont.	Orlon Plt.	.....	.....	Planning	.....	.....	.....	.....
Goodrich, Canada	Niagara Falls	Polyvinyl Geon	.....	$3,500,000	Planning	Early 1957	.....	McKee	McKee
Imperial Oil	Halifax	Powerformer	6,300 bbls.	$4,300,000	Under Constr.	March, 1957	Esso	Foster Wheeler	Foster Wheeler
	Sarnia	Detergent Alkylate	.....	$5,000,000	Under Constr.	Mid 1957	.....	.....	.....
		Petrochemical Plt.	.....	$25,000,000	Engineering	Summer, 1958	.....	Canadian Bechtel	Canadian Bechtel
	Montreal	Cat. Reformer	9,000 bbls.	$5,100,000	Under Constr.	April, 1957	.....	Fluor	Fluor
	Ioco, B.C.	Powerformer Prefractionator, Hydrofiner	5,000 bbls.	$4,000,000	Engineering	Dec., 1957	Esso	Bechtel: Staff	Bechtel
	Winnipeg	Add. Crude Cap.	2,500 bbls.	$4,500,000	Under Constr.	Early 1958	.....	.....	Foster Wheeler
	Calgary	Powerformer	2,850 bbls.						
		*Refinery Exp.	18,400 bbls.	$17,000,000	.....	.....	.....	.....	.....
Jefferson Lake Sulphur	Taylor Flats, B.C.	*Sulfur Recovery Plt.	425 tons	$1,800,000	Under Constr.	Fall, 1957	.....	Parsons	Parsons
McColl-Frontenac	Edmonton, Alta.	Platformer	3,300 bbls.	$900,000	Engineering	1957	UOP	Treco	Treco
	Montreal East	Hydratreater	10,000 bbls.	$1,000,000	Engineering	Late, 1957	Texas Co.	Foster Wheeler	Foster Wheeler, Ltd.
Midland Pet. & Pacific Pet.	Stettler, Alta.	Crude Refinery	4,000 bbls.	$2,000,000	Under Constr.	.....	.....	.....	.....
Northwest Nitro Chemical	Medicine Hat, Alta.	Phosphoric-Acid Plt.	.....	.....	Complete	.....	.....	Fluor	Fluor
Pacific Petroleum	Fort St. John, B.C.	Gas-Absorption Plt.	.....	$18,000,000	Planning	.....	.....	.....	.....
Pacific Petroleum & Phillips Petroleum	Taylor, B.C.	Refinery Expansion	.....	.....	Under Constr.	Fall, 1957	.....	Stern-Rogers	Stern-Rogers
Polymer Corp., Ltd.	Sarnia, Ont.	Ethylene Plt. Expan.	.....	$2,000,000	Under Constr.	Early 1957	.....	Staff	Staff
		Plt. Expansion	.....	.....	Engineering	.....	.....	Catalytic	Canadian General Electric
	Alberta	*Butadiene Plt.	.....	.....	Planning	.....	.....	.....	.....
Quebe Ammonia	Montreal	Ammonia Nitric Acid—80 tons Nitrogen Solutions	120 tons	$8,000,000	Planning	.....	Texaco	Girdler	Girdler
Regent Refining	Port Credit, Ont.	Fluid Cat Cracker, Vacuum Distillation, Gas Polymerization	.....	$5,500,000	Planning	1957	.....	Procon	Procon
Royalite Oil	Kamloops, B.C.	*Platformer	1,000 bbls.	.....	Engineering	Nov., 1957	UOP	UOP	.....
		*Unifiner	1,500 bbls.	.....	Engineering	Nov., 1957	UOP	UOP	.....
Shawinigan	Montreal, East	Exp. Phenol Plt.	.....	.....	Under Constr.	Early 1957	.....	Staff	Staff
Shell Oil (Canada)	Alberta	Refinery	.....	.....	Studying	.....	.....	.....	.....
	Bronte, Ont.	Refinery	.....	.....	Considering	.....	.....	.....	.....
Sherritt-Gordon Mines, Ltd.	Fort Saskatchewan, Alta.	Anhydrous Ammonia	75 tons	$24,000,000	Planned	.....	.....	.....	.....
LATIN AMERICA									
Brazil									
Alba (Borden)	Cubatao	Methanol, Formaldehyde, Synthetic Resins	30 tons	$3,500,000	Engineering	1958	Vulcan	Vulcan Girdler	Staff Girdler
Copebras	Cubatao	Carbon-Black	18,000 tons/yr.	.....	Engineering	.....	.....	.....	.....
Petrobras	North Brazil	Refinery	25,000 bbls.	.....	Studying	.....	.....	.....	.....
	South Brazil	Refinery	70,000 bbls.	.....	Studying	.....	.....	.....	.....
	Cubatao	Ethylene Recovery Unit	40,000,000 lbs./yr.	.....	Under Constr.	Mid 1957	.....	Hydrocarbon, Edeleanu	.....
	Mataripe	Atmospheric & Vacuum Distil. Units, Cat. Crkr, Gas Recovery, Wax Treating	37,000 bbls.	.....	Engineering	Mid 1959	Kellogg	Kellogg	Kellogg
	Rio de Janeiro	New Refinery	90,000 bbls.	.....	Studying	1960	.....	.....	.....
Uhde	Cubatao	Urea Pet.	.....	.....	.....	.....	.....	Uhde	Uhde
Union Carbide	Cubatao	Polyethylene	.....	.....	Under Constr.	Early 1958	.....	Brown & Root	Brown & Root, Ltd.
Colombia									
Colombian Petroleum Company	Barco Concession	Gas Absorption	2,000 bbls.	$5,000,000	Complete	.....	.....	.....	Fluor
Empresso Colombiana de	El Centro	Plt. Modernization	2,000 bbls.	$3,000,000	Planning	.....	.....	.....	.....
Empressa Nacional Petroleos	Barranca Bermeja	Exp. Propane Recovery	2,000 bbls.	$3,000,000	Planning	.....	.....	.....	.....
		Petrochemicals	.....	.....	Planning	.....	.....	.....	.....
International Petroleum (Colombia), Ltd.	Cartagena	Refinery	26,500 bbls.	$32,500,000	Under Constr.	3rd Qtr., 1957	Esso	Bechtel	Bechtel
Cuba									
Esso Standard	Havana	Ref. Expan.; Distillation, Polymerization, Powerforming, Hydroforming, Cat. Cracking	To 35,000 bbls.	$30,000,000	Under Constr.	Late 1957	Esso	McKee	McKee
Refinadora Cabaiguan	Cabaigun, Cuba	Ref. Expan.	.....	.....	Planning	.....	.....	.....	.....
The Texas Co.	Santiago	Refinery	20,000 bbls.	$14,000,000	Under Constr.	Early 1957	.....	.....	.....
Mexico									
Celanese Mexicana, S.A.	Mexico City	*Formaldehyde; *Synthetic Resin	.....	.....	Under Constr.	.....	.....	.....	.....
Central Minera, S.A.	Texistepec, Mex.	*Sulphur Plt.	1,000 tons	$3,500,000	Under Constr.	March, 1958	.....	.....	.....
Pemex	Mexico City	Cat Cracking, Gas Concentration, HF Alkylation; Polymerization; Ethylene; Sulfure	16,000 bbls.	$12,500,000	Under Constr.	Late 1957	Esso-Phillips, U.O.P.	McKee	Staff

* First appearance in tabulation † Added capacity

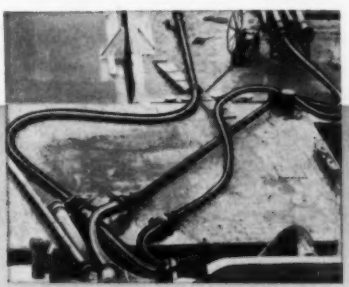
Construction BOXSCORE Continued on Page 255

US RUBBER OIL TRANSPORT HOSE

Announcing

A COMPLETE LINE OF PETROLEUM TRANSPORT HOSE

A hose for every purpose from U.S. Rubber...



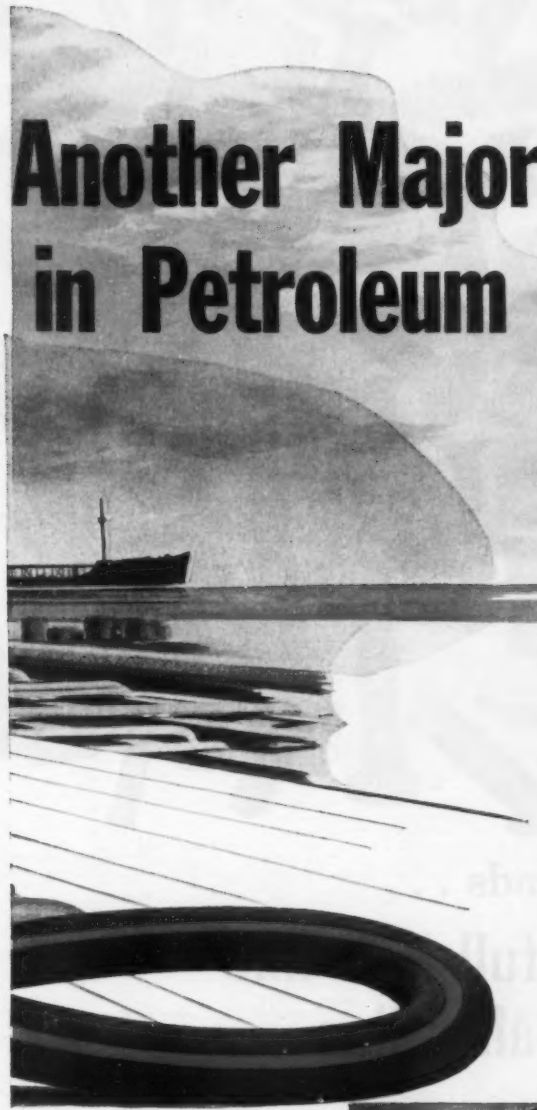
FIRST with U. S. Amazon H-1515 Oil Discharge Hose.

Flexible smooth-bore, ⅔ lighter, takes up to 200 lbs. working pressure, needs less handling gear. Make-up time is reduced and accident hazards lessened.

FIRST with U. S. Amazon H-1818 Smooth Bore O S & D Hose.

Takes up to 200 lbs. operating pressure, withstands the roughest handling, has up to 100% greater hydrostatic values, extreme flexibility. H-1818 is the only burstproof smooth-bore hose.

Another Major Achievement in Petroleum Transport Hose



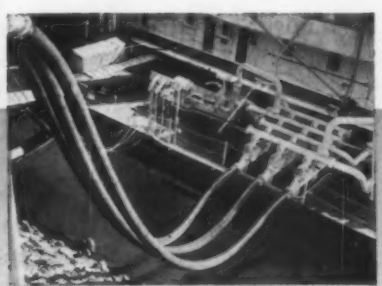
Now, from U. S. Rubber, the world's pioneer oil hose manufacturer, comes new additions to its line of Amazon® petroleum dock hose. There is a hose for every requirement—dock, barge loading and general loading services — rough bore or smooth, for extra high or normal working pressures.

Each hose has qualities that cannot be found in any other make hose of similar type — qualities of easier handling, greater flexibility, higher hydrostatic value — all of which make U. S. Amazon superior to any other hose on the market.

The new, complete line of U. S. Amazon petroleum transport hose is obtainable at any of the 28 District Sales Offices, or by contacting us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.

AND NOW
TO COMPLETE THIS MOST UP-TO-DATE LINE OF DOCK HOSE, U.S. RUBBER IS ONCE AGAIN...

FIRST with U. S. Amazon H-2020 Rough Bore Oil Suction & Discharge Hose.
For 200 lbs. working pressure. Both inner and outer supporting wires double the hydrostatic values. Also suitable for hot asphalt and heated oils. Absolutely burstproof.



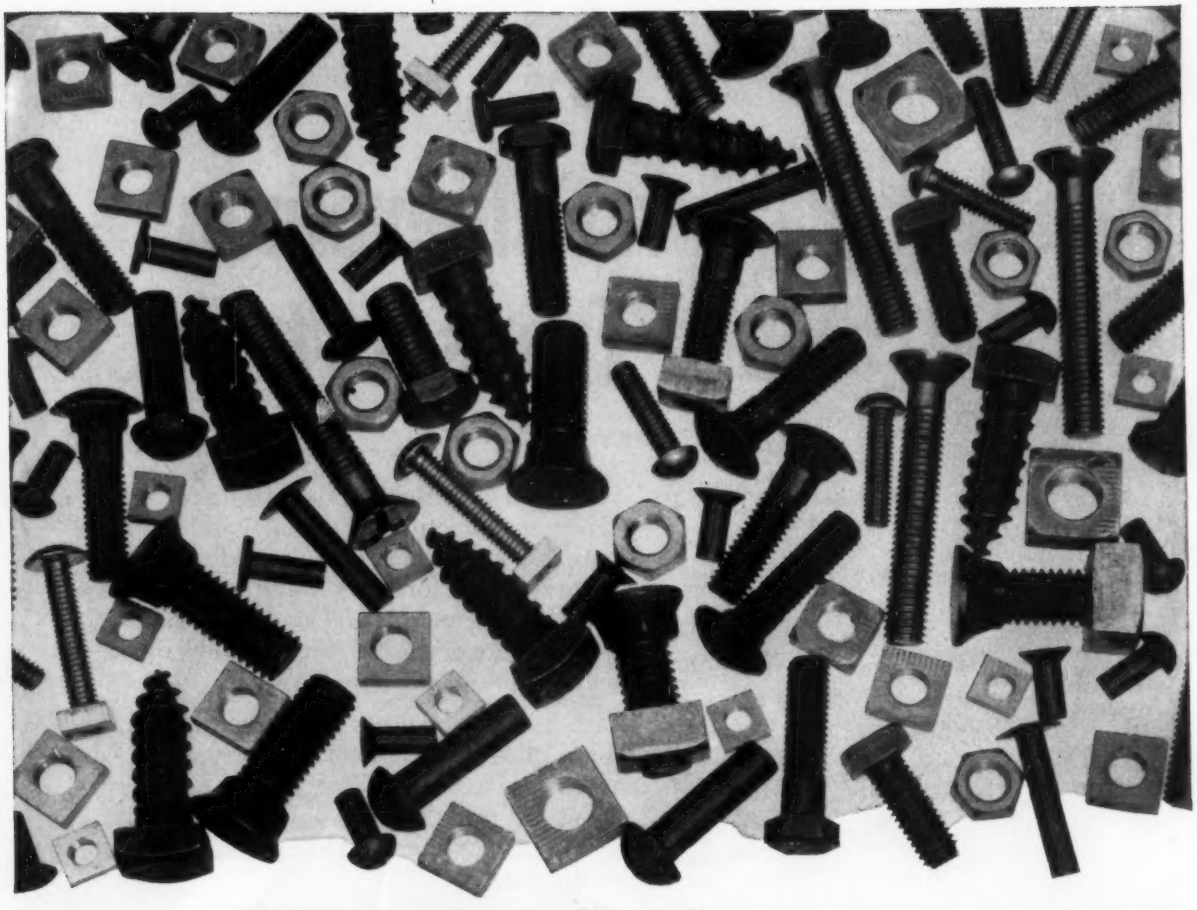
FIRST with U. S. Amazon H-2424 Rough Bore Wire Cord O S & D Hose.
For 150 lbs. working pressure, contains inner supporting wire in bore; specially designed carcass has each wire imbedded in its own neoprene layer. Conducts any petroleum product. Very flexible.

US RUBBER

Mechanical Goods Division

United States Rubber

For more data on advertised products, use Readers' Service Cards, last page.



From heads to threads . . .

You'll find Sheffield's full bolt line is a precision-made quality line

Quality-controlled from steelmaking to finished bolt. Sheffield bolts and cap screws give you an unbeatable combination of Sheffield's own special analysis steel and fine manufacturing precision. We're old hands at it—making bolt and nut products since 1888.

Precision-formed: A Sheffield bolt-and-nut assembly, like a precision machine, is made to close tolerances. Holds tight when the pressure's on, and stands up under toughest conditions. Free-running threads save installation time.

You'll get exactly what you want—fast—when you order from Sheffield's FULL line of standard and special bolts and cap screws. Or, if yours is an unusual need, Sheffield has finest facilities for making fasteners to your blueprint specifications. We'll help you select the most economical way to solve any fastening problem. Get in touch with your nearest Sheffield office now.

SHEFFIELD

ARMCO

Bolt Products

SHEFFIELD DIVISION ARMCO STEEL CORPORATION SHEFFIELD PLANTS: HOUSTON • KANSAS CITY • TULSA

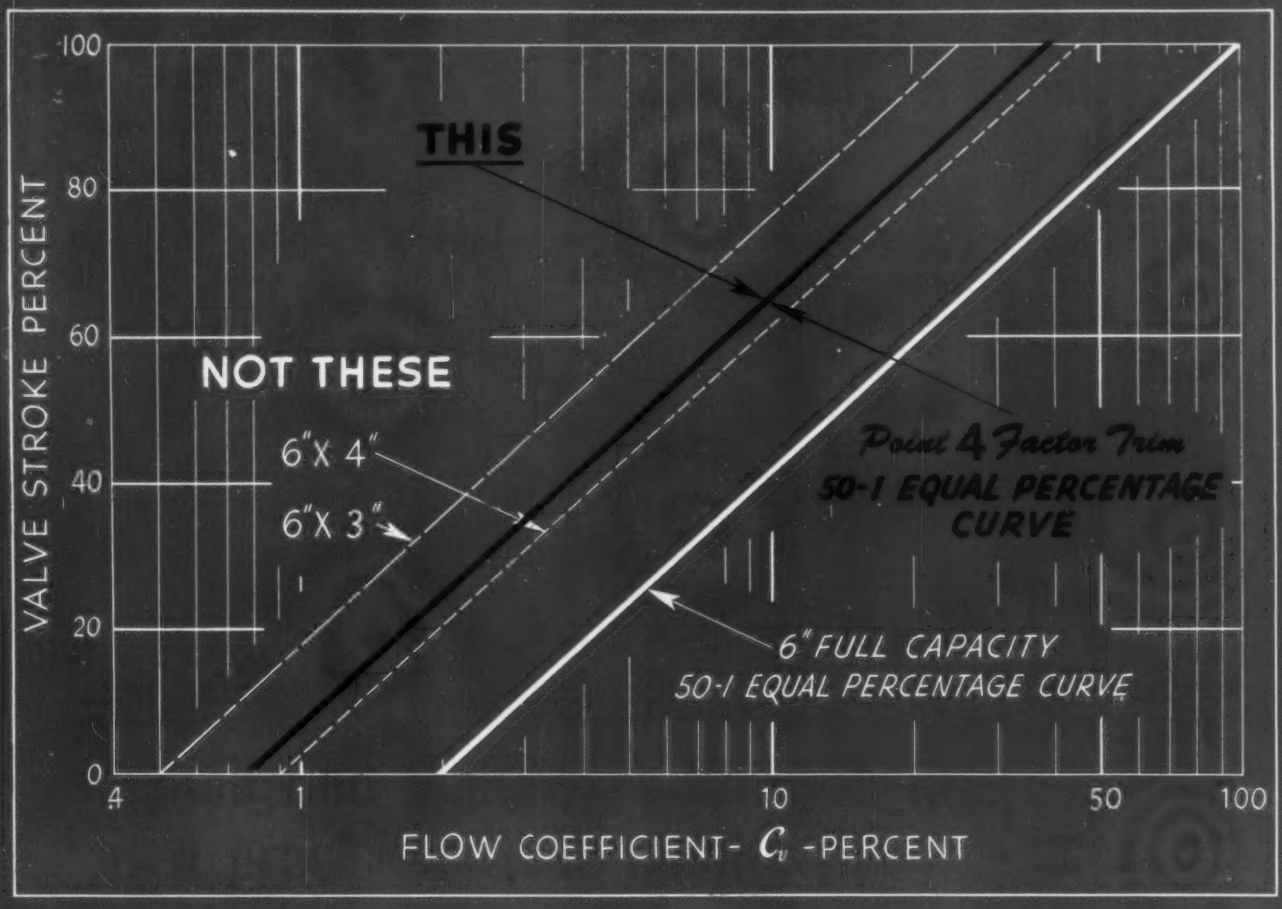
CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Pemex (Continued)	Pemex City	Nat. Gaso. Plt.	300 Mmcf	$7,400,000	Under Constr.	Mid 1957	.....	Hudson	Staff
	Cuidad Madero	Topping	100,000 bbls.						
		Cat. Cracking	16,000 bbls.						
		Gas Concentration; HF Alkylation; Polymerization; Sulfure Plt.		$25,700,000	Under Constr.	Mid 1958	Phillips, Esso, UOP	McKee	Staff
	Minatitlan	Vacuum Distillation; Clay Treating; Lube Oil	1,000 bbls.	$2,500,000	Under Constr.	Late 1957	.....	Fluor	Staff
	Salamanca	Grease Plt.	25 tons	$1,700,000	Engineering	Early 1957	.....	McKee	Staff
		Cat. Cracker	15,000 bbls.	.....	Planning	.....	.....	.....	.....
	Posa Rica.....	Topping Plt.	10,000 bbls.	$1,350,000	Engineering	Mid 1957	.....	Staff	Staff
Netherlands Antilles									
N. V. Curacaosche Petro. Ind, Mij.	Curacao	Feed Prep.	20,000 bbls.	.....	.....	Mid 1957	.....	S. & W. Badger	.....
			33,000 bbls.	.....	Planned	End 1957	.....	Div., E. B. Badger, Ltd.	.....
		Cat. Cracker	33,000 bbls.	.....	Under Constr.	Late 1957	.....	N. V. De Bataafsche Pet. Mij.	Werkspoor, N.V.
Panama									
National Bulk Carriers	Colon	*Refinery	.....	$33,000,000	Planning	.....	.....	.....	.....
Private Investment Firm	Near Colon	*Refinery	.....	.....	Planning	.....	.....	.....	.....
Refiner a Petroquimica de Panama	Colon	Refinery	55,000 bbls.	.....	Planning	.....	.....	.....	.....
Refineria Panama....	Las Minas Bay, Cozon	Refinery; Petrochemicals	70,000 bbles.	$59,000,000	Under Constr.	1959	.....	Pet. Comb. & Eng. Co.	Pet. Comb. & Eng. Co.
Peru									
Fertiza Limitada.....	Peru	Fertilizer Plt.	.....	.....	Planning	1957	.....	Montecatini	.....
Helios, S.A.....	San Andres	Fertilizer Plt.	130,000 tons	.....	Planning	.....	.....	.....	.....
Puerto Rico									
Commonwealth Oil Refining Co.	Guayanilla Bay	Refinery	30,000 bbls.	.....	Under Constr.	Mid 1957	.....	.....	Lummus
Union Carbide Caribe	Ponce	Ethylene-Glycol	.....	$28,500,000	Planning	Mid 1958	.....	.....	.....
Trinidad									
W. R. Grace and Co..	Trinidad	*Chemical Plt.	.....	$10,000,000	Considering	.....	.....	.....	.....
Venezuela									
Mene Grande-Creole.	San Joaquin	Gasoline Plt.	.....	$2,300,000	Complete	.....	.....	.....	.....
Cia. Shell de Venezuela	Cardon	Cat Cracker	33,000 bbls.	.....	Under Constr.	1st Qtr., 1957	.....	.....	.....
		Polymerization; Treater, Feed Preparation	.....	.....	Under Constr.	.....	.....	H.W.P.	.....
		Distillation	80,000 bbls.	$20,000,000	Planning	Mid 1958	.....	.....	.....
		Alkylation	2,300 bbls.	.....	Under Constr.	1st Qtr., 1957	.....	.....	.....
		Cat. Cracker	33,000 bbls.	.....	Under Constr.	2nd Qtr., 1957	.....	.....	.....
		Alkylation Plt.	2,300 bbls.	.....	Under Constr.	3rd Qtr., 1957	.....	.....	.....
		Distillation	80,000 bbls.	.....	Projected	2nd Qtr., 1957	.....	.....	.....
Creole Pet. Corp.....	Amuay Bay	Pipe Still	70,000 bbls.	$10,800,000	Under Constr.	.....	.....	Foster Wheeler	Foster Wheeler
		Lube Hydrofiner	14,500 bbls.	$3,000,000	Under Constr.	.....	.....	Foster Wheeler	Foster Wheeler
		Phenol Extraction Unit, Propane Dewaxing Plt., Lube Handling	.....	.....	.....	.....	.....	.....	.....
		*Distillation	100,000 bbls.	$13,500,000	Under Constr.	April, 1957	.....	.....	.....
		*Hydrofining Plt.	14,500 bbls.	$3,000,000	Under Constr.	Feb., 1958	.....	.....	Foster Wheeler
		*Lube Oil Plt.	500 bbls.	.....	Under Constr.	Jan., 1958	Esso	Foster Wheeler	Foster Wheeler
	Lake Maracaibo	*LPG Plt.	17,000 bbls.	$11,173,000	Engineering	Jan., 1958	Creole	Tellepsen	.....
Richmond Exploration	Maracaibo	Asphalt Plt.	10,000 bbls.	$4,000,000	Complete	.....	.....	Stand.-Calif.	Lummus
Venezuelan Govt.....	Venezuela	Ammonia Synthesis Gas	120 tons	$1,000,000	Planning	1957	.....	Air Products	Air Products
EUROPE AND AFRICA									
Belgium									
Esso Standard.....	Antwerp	*Powerformer	5,600 bbls.	.....	Under Constr.	Early 1958	.....	Badger N.V.	Badger N.V.
		*Hydrofiner	6,900 bbls.	$6,000,000	Under Constr.	Early 1958	.....	Badger N.V.	Badger N.V.
		Cat. Reformer	5,600 bbls.	.....	Engineering	Mid 1958	.....	Esso	Badger-Comprimo
		*Desulfurization	6,000 bbls.						
Petrochim.....	Antwerp	Ethylene Oxide, Ethylene Glycol	.....	$8,000,000	Engineering	.....	SDC	SDC	.....
Raf Belge de Petroles.	Antwerp	Cat. Reformer	2,500 bbls.	$2,000,000	Under Constr.	Mid 1957	Sinclair-Baker	KIC	KIC
		Desulfurization	.....	.....	Engineering	.....	Sinclair-Baker	KIC	KIC
Soc. Industrielle Belge de Petrolee	Antwerp	Ref. Exp.	70,000	.....	Complete	.....	.....	SIBP; Kellogg	Kellogg
		Ref. Exp.	85,000	.....	Planning	1957	.....	Kellogg; SIBP	Kellogg
		Cat. Reformer	10,000 bbls.	.....	Under Constr.	Early 1958	.....	Kellogg; UOP	Kellogg
		Hydrofiner	10,000 bbls.	.....	Under Constr.	Early 1958	.....	Kellogg	Kellogg
Egypt									
Anglo-Egyptian Oilfields	Suez	Cat. Reformer	2,300 bbls.	.....	Projected	3rd Qtr. 1957	.....	.....	.....
		Power Plt.	10,000 KW.	$2,100,000	Planned	1958	.....	Italian	Firms
		Mech. Workshop	.....	$860,000	Planned	March, 1957	.....	.....	Local
		Cooling Tower. & Accessories	120,000 tons	$250,000	Under Constr.	March, 1957	.....	Local	Local
		Atmos. Dist., Voc. Dist. & Lube Oils	20,000 bbls.	$6,000,000	Planning	.....	.....	.....	.....
		Vapor Recovery & Bottling	70 tons	$1,000,000	Planned	Dec., 1957	.....	Lummus	Lummus
England									
Berry, Wiggins & Co., Ltd.	Weaste Ref., Manchester	Extension to Refinery	1,600 bbls.	.....	Under Constr.	.....	.....	H.W.P.	H.W.P.
British Petroleum....	Kent	TWC Hydrofiners	10,000 bbls. ea.	.....	Under Constr.	Mid 1958	.....	Kellogg	McAlpine, Winpey
		Alkylation Plt.	2,250 bbls.	.....	Under Constr.	Early 1958	.....	Lummus	
		Distillation Unit	90,000 bbls.	.....	Under Constr.	Late 1957	.....	Badger, Ltd.	
		Cat. Reformer	10,000 bbls.	.....	Under Constr.	Early 1958	.....	UOP, Kellogg	
		Thermal Reforming	12,000 bbls.	.....	Under Constr.	Mid 1958	.....	Kellogg	
		Aromantic Recovery; Isopentane Fractionation; Depropanizer; Isopentane Washer	.....	.....	Engineering	.....	.....	S&W Badger Div., E. B. Badger, Ltd.	.....
Eastern Gas Board...	Bedford	*Oil Gasification	2,000,000 cu. ft.	.....	Under Constr.	Aug., 1957	.....	H & G	H & G
	Dunstable	*Oil Gasification	6,000,000 cu. ft.	.....	Planning	Spring 1958	.....	H & G	H & G
East Midlands Gas Board	Sheffield	*Oil Gasification	10,000,000 cu. ft.	.....	Under Constr.	Nov., 1957	.....	H & G	H & G
	Northampton	*Oil Gasification	6,000,000 cu. ft.	.....	Planning	Dec., 1957	.....	H & G	H & G
Esso Petroleum Co....	Fawley	Refinery Expan.	†35,000 bbls.	$14,300,000	Complete	.....	.....	Esso	Foster Wheeler
		Hydrofining	12,000 bbls.		Under Constr.				

* First appearance in tabulation † Added capacity

Construction BOXSCORE Continued on Page 259

One Size...



A HIGH C_Q (Quality Coefficient) PRODUCT

Point 4 Factor Trim

is the answer to those few types of applications where reduced capacity trim is required. It is available in V-port and solid turned designs for double or single seated valves and in a wide variety of materials. Send for Data Sheet No. 10-5.

Not Two

Masoneilan *Point 4 Factor Trim* offers the ONLY REALISTIC approach to selection of reduced capacity trim

It is a DEMONSTRABLE Fact that for a given size top-and-bottom guided valve only *one* size reduced capacity trim is:

Desirable from an engineering standpoint because . . .

(a) properly designed wide-range valves with full capacity trim will handle a vast majority of control problems.

(b) if any reduction is required, it must be substantial to be of any advantage.

(c) any sound design must be based on a reduction in seat ring diameter.

(d) rule-of-thumb trim reductions based on nominal *pipe* sizes are unnecessary and merely complicate the sizing problem.

Practical from manufacturing and operating standpoint because . . .

(a) mechanical strength is retained with standard guide and stem diameters and standard stroke, in combination with maximum reduction in seat diameter.

(b) reduction in number of parts simplifies stock problem.

(c) forged and cast forms insure complete uniformity of parts.

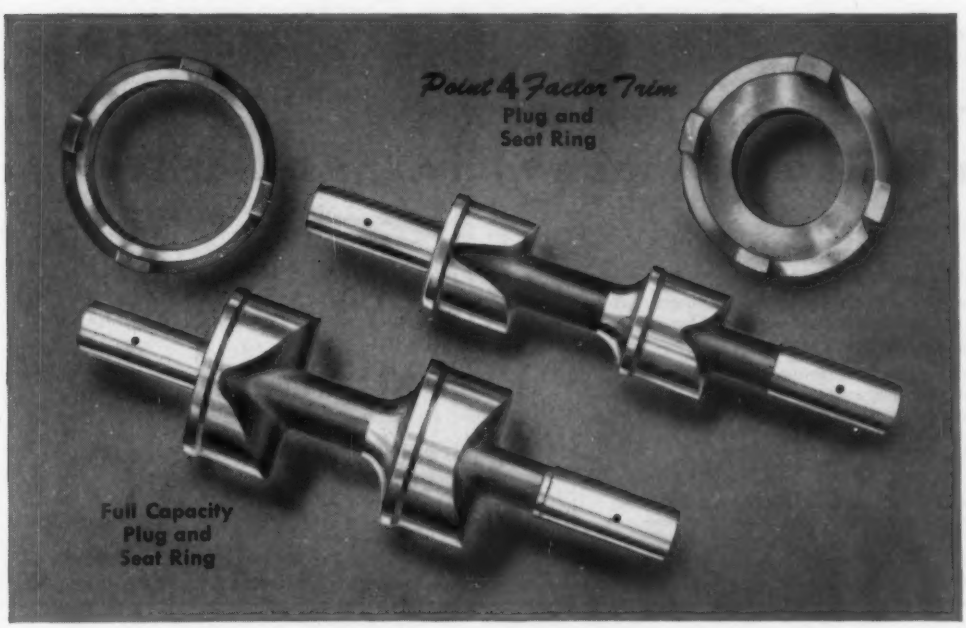
MASONEILAN

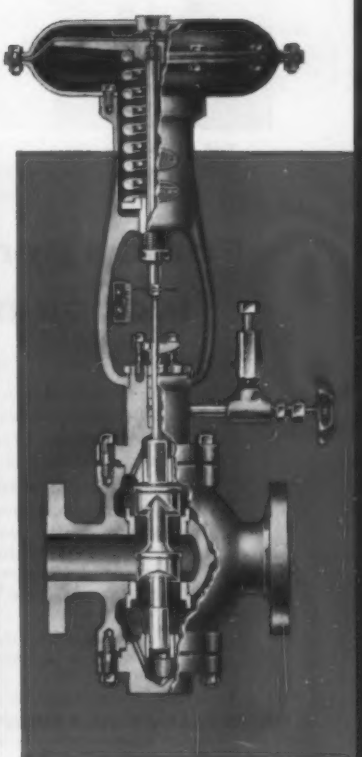
MASON-NEILAN

Division of Worthington Corporation

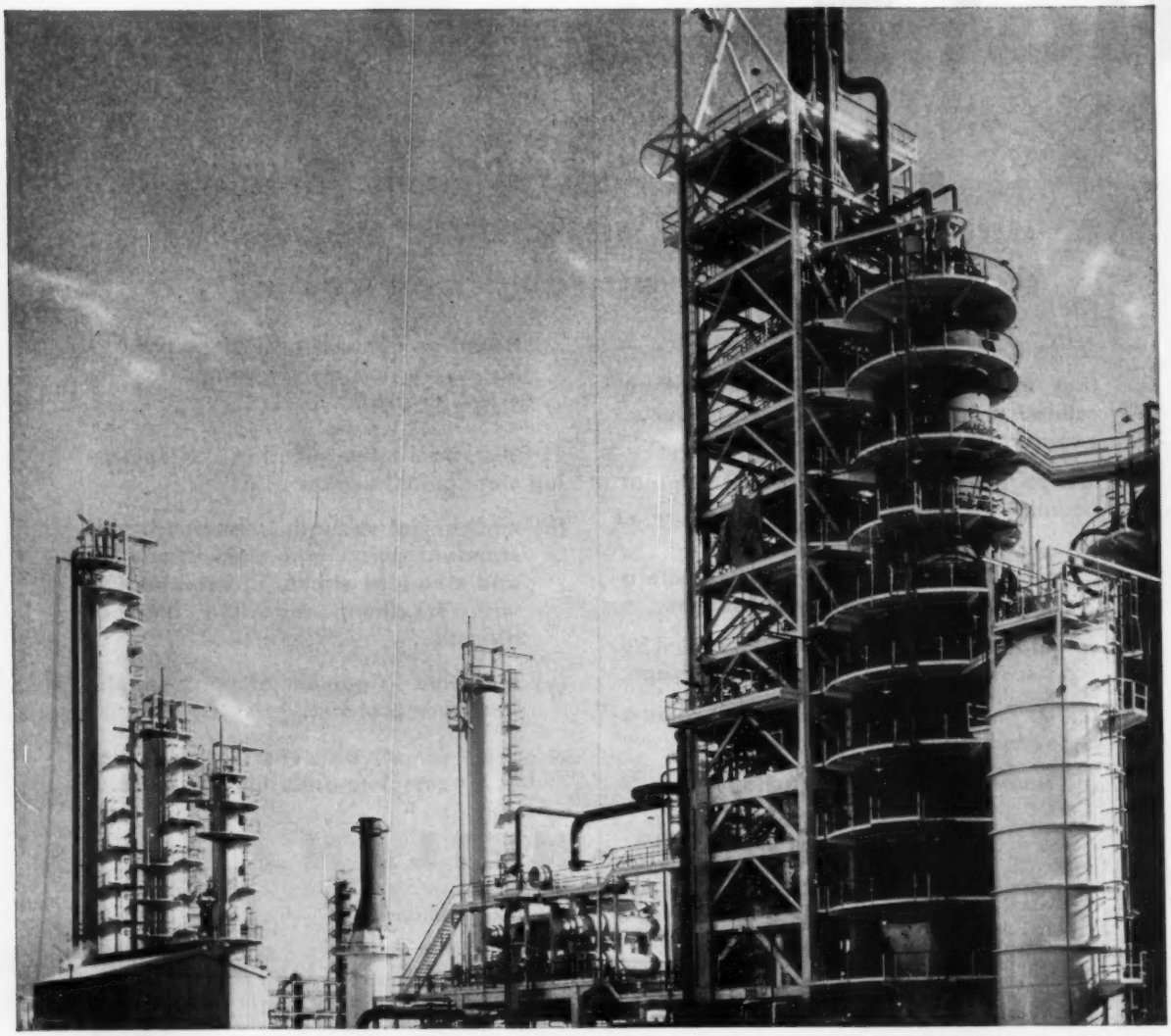
51 NAHATAN STREET, NORWOOD, MASSACHUSETTS

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa • Philadelphia • Houston • Pittsburgh • Atlanta • Cleveland • Cincinnati • Livonia • San Francisco • Boise • Louisville • Salt Lake City • El Paso • Albuquerque • Odessa • Charlotte • Los Angeles • Corpus Christi • Denver • Appleton • Birmingham • New Orleans • Dallas • Seattle • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto





For more data on advertised products, use Readers' Service Cards, last page.



THE REGENERATOR of this fluid hydroformer at Baton Rouge refinery of Esso Standard Oil Company has been lined with refractory insulating concrete made with Lumnite cement. Refineries also use Lumnite for linings in heaters, catalyst transfer and discharge lines and reactor cyclones.

For top performance in refineries — industrial concretes made with Atlas LUMNITE*

- Lumnite industrial concretes with suitable aggregates provide insulation, resist heat and corrosion.
- Production loss due to repairs is minimized because placement is fast and easy. Service strength is reached within 24 hours.
- Lumnite concretes extend service life of installations.

For maximum convenience, use Lumnite-made castables. These are premixed, ready for use, and are made and distributed by leading manufacturers of refractories. For more information write: Universal Atlas, 100 Park Avenue, New York 17, N. Y.

UNIVERSAL ATLAS CEMENTS

USS

* **"LUMNITE"** is the registered trademark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

L-149

UNIVERSAL ATLAS CEMENT COMPANY—member of the industrial family that serves the nation—**UNITED STATES STEEL**

OFFICES: *Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco*

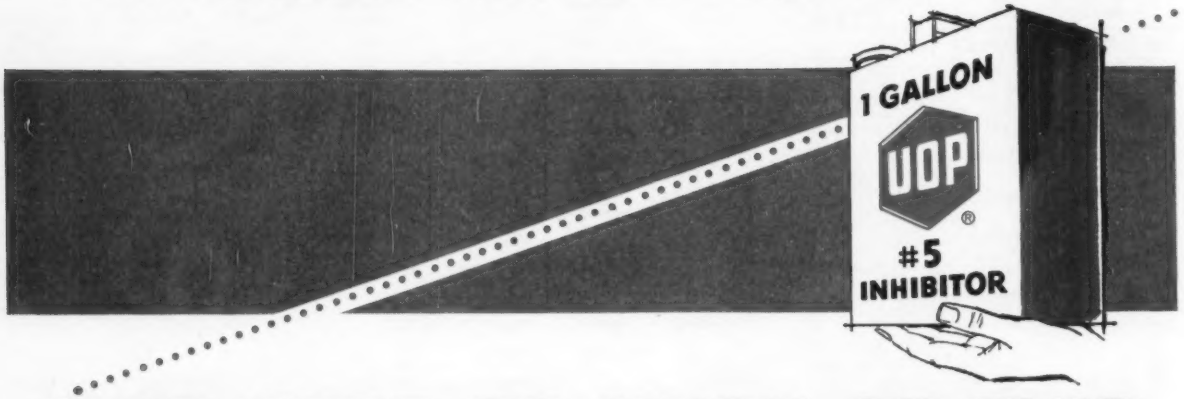
CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Esso Petroleum	Fawley	*Ethylene & Butadiene Plt.		$27,000,000	Engineering	Mid, 1958		Staff	Foster Wheeler
		*Hydrofiner	12,000 bbls.	$2,750,000	Under Constr.	Mid, 1957		Staff	Foster Wheeler
		*Sulfur Plt.	60 tons	$700,000	Engineering	1st Qtr., 1958		Staff	Foster Wheeler
		*Crude Pipestill	70,000 bbls.	$5,000,000	Under Constr.	4th Qtr., 1957		Staff	Foster Wheeler
Hedon Chemicals	Hedon, Yorks.	Vinyl Acetate			Under Constr.				
International Synthetic Rubber	Fawley	Synthetic Rubber	50,000 ton/yr.	$12,000,000	Engineering	1957		Blaw Knox	Blaw Knox
Mobil Oil Co., Ltd.	Coryton	Cat. Hydrodesulfurization			Pre-engineering				
		Crude Unit Exp.			Pre-engineering				
Monsanto Chemicals	Britain	Add Polystyrene			Under Constr.			Staff	Staff
		Styrene-Butadiene Copolymer Plt.	4,000 ton/yr.	$14,000,000	Planned				
North Thames Gas Board	Romford	*Oil Gasification	4,000,000 cu. ft.		Under Constr.	Sept., 1957		H & G	H & G
		*Refinery Gas Reforming	36,000,000 cu. ft		Under Constr.	Spring, 1958		H & G	H & G
Regent Oil	Southern England	Refinery			Planning	1958			
Shell Chemical	Shell Haven	Ammonia; Nitric Acid	75,000 tons/yr.	$18,500,000	Planning	1958			
		Fertilizer		$12,500,000	Planning				
	Partington	Ethylene Oxide	25,000 tons/yr.			Mid, 1958			
Shell Refining	Shell Haven	Atmospheric Distil.	80,000 bbls.		Engineering	Late 1958		S&W Badger Div., E. B. Badger, Ltd.	E. B. Badger Ltd.
South Eastern Gas Board	Isle of Grain	Oil Gasification	15 Mmcf		Under Constr.	Fall, 1958		Power Gas	Power Gas
West Midlands Gas Board	Bilston	*Oil Gasification	3,000,000 cu. ft.		Under Constr.	April, 1957		H & G	H & G
	Coventry	*Oil Gasification	6,000,000 cu. ft.		Under Constr.	April, 1957		H & G	H & G
Finland									
Neste Oy Corp	Turku	Refinery	14,000 bbls.	$17,500,000	Planning		Atlantic, Soc. Mob., Calif. Res.		
France									
Antar Petroles de l'Atlantic	Donges	Cat. Reformer	13,000 bbls.		Under Constr.		Houdry, UOP	Hydrocarbon, Hydro M.	Staff
Bassin de Lorraine	Carling	Styrene Monomer						S.B.A.	S.B.A.
Cabot of France	Berre Lake	Carbon-Black Plt.			Planning	1957			
Caltex S.D.F.	Ambes	Cat. Cracker	4,700 bbls.		Under Constr.	1957		Lummus	Lummus
		Vacuum Unit	6,600 bbls.		Under Constr.	1957		Lummus	Lummus
		Poly Plt.	540 bbls. (Product)		Complete		C.R.C.	Foster Wheeler	Lummus
Comp Francaise de Raffinage	Provence	Desulfurization						KIC	KIC
		*Powerformer	20,000 bbls.					Foster Wheeler	Foster Wheeler
Esso Standard	Girdonde-Bordeaux	Refinery	31,500 bbls. Expandable to 45,000 bbls.		Planning	1959	Esso	Lummus	Lummus
	Port Jerome	Cat. Cracker	10,000 bbls.	$11,000,000	Planning	Early 1957		Foster Wheeler	Foster Wheeler
		*Powerformer			Under Constr.	2nd Qtr., 1958	Esso	Foster Wheeler	Foster Wheeler
	Bec-d' Ambes	*Refinery	31,500 to 45,000 bbls.		Under Constr.	1959	Esso	Lummus	Lummus
Francolor	France	Maleic-Anhydride			Engineering		SDC		
Mobil Oil Francaise	Graveenchon	Cat. Hydrosulfurization			Engineering	Sept., 1957		Staff	
		Lube Expansion			Pre-engineering				
Naphtachimie	Lavera	Exp. Ethylene Oxide			Under Constr.	1957	SDC	S&W Badger Div.	
		Expand Ethylene			Under Constr.	1957		S&W, E.B. Badger, Ltd.	
Pechiney	St. Auban	Perchlorethylene Plt.			Planning		SDC	SDC	
Potasse et Engrais Chimiques	Grand Couronne	Ammonia					SBA	KIC	KIC
Societe du Caoutchouc Butyl	Le Havre	Synthetic Rubber Plt.	20,000 tons/yr.		Engineering	Mid 1958	ESSO		
Soc. Francaise des Petroles BP	Dunkirk	Cat. Reformer	10,000 bbls.		Planning	Early 1958		UOP; Kellogg	
	Lavera	Distillation	50,000 bbls.		Under Constr.	Late 1957		Foster Wheeler	Foster Wheeler
Soc. Nationale des Petroles D'Aquitaine	Lacq	Sulfur Recovery			Planning			Parsons	Parsons
Soc. Rhone-Poulence	Gonfreville	Polyethylene			Licensed		Phillips		
	France	Polyethylene			Engineering		SDC		
West Germany									
Badische Aniline und Soda Fabrik	Ludurigshafen	Polyethylene			Licensed		Phillips		
Bensin und Petroleum	Hamberg-Finkenwerder	Hydrofiner	6,500 bbls.		Under Constr.	Mid 1957		Uhde	
Buna Werke Huls G.m.b.H.	Marl, Kreis Recklinghausen, Western Germany	Hydrofiner; Synthetic Rubber Plt.	45,000	$37,000,000	Under Constr.	Summer 1958	Esso R&E; Houdry; Firestone	Staff	Staff
Deutsche Vacuum Oil	Brenen-Osleb-shausen	Sovaformer	3,200 bbls.						
		Sovafiner Sulfur Plt.	4,800 bbls.		Under Constr.	1957	Socony-Mobil		
Deutsche Shell	Harburg	Distillation							
		Cat. Reformer							
		Crude Distiller							
		Cat. Reformer	37,000 bbls.		Under Constr.	End 1958			
		Hydrodesulfurization							
	Wesseling	*Refinery	3,000,000 tons		Planning				
Esso A.G.	Cologne	*Refinery		$39,000,000	Engineering	Jan., 1959	Esso	Braun	Braun & Others
		Atmospheric Crude Distl.	72,000 bbls.						
		Powerformer	9,000 bbls.						
		Gas-Oil Hydrofiner	11,000 bbls.						
		Steam Cracker	5,600 bbls.						
		Sulfur Recovery	22,000,000 tons						
Etablissements Kuhlmann		Ammonia Plt.	60 tons				Texaco	Kuhlmann	Kuhlmann
Kohle-Oil Chemie	Gelsenkirchen	Polyethylene	24,000 tons/yr.		Planning				
Mobil Oil A.G.	Bremen	Cat. Reforming			Under Constr.	1st Qtr., 1957		Braun	
		Cat. Hydrodesulfurization			Under Constr.	1st Qtr., 1957		Braun	
		Crude Two Stage			Pre-engineering	Dec., 1957			
Ruhrbau	Mulheim	Refinery	15,000 bbls.		Planning				
Socony Mobil	Bremen	Hydrodesulfurization	5,500 bbls.					Braun	Braun
Greece									
Greek Government	Pireaus	Refinery	30,000 bbls.	$15,000,000	Under Constr.	1st Qtr., 1957	Atlantic	Hydrocarbon	Hydro. M., Krupp, Stahlunion, Stahlbau

* First appearance in tabulation † Added capacity

Construction BOXSCORE Continued on Page 261

* IT TAKES SO LITTLE OF THIS



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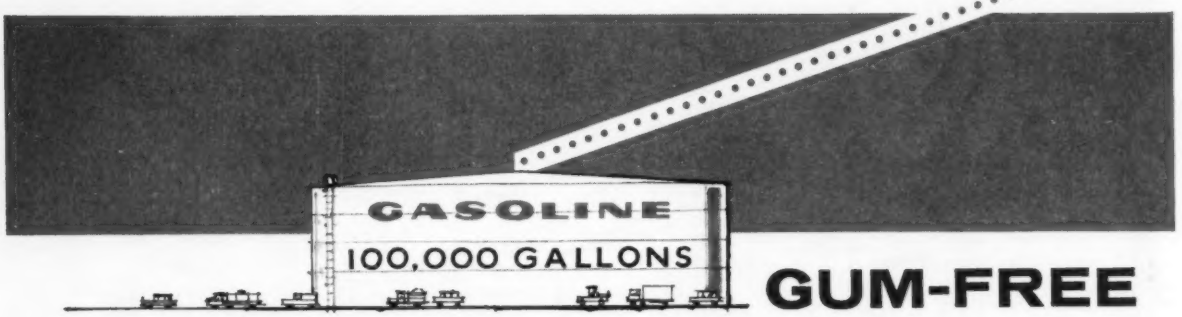


GUM-FREE

Even though UOP #5 Inhibitor is the most economical you can use (only 5 molecules of UOP #5 protect as many as 1,000,000 molecules of gasoline), it is also the only inhibitor that can handle the tough stability jobs.

The formation of gum in modern gasolines is the one universally recognized cause of engine manifold deposits. UOP Inhibitor #5 has been proven, by test and actual use, the best preventative for this. It's effective, too, in preventing the decomposition of TEL in stored gasolines.

UOP's technical staff has pioneered the development of techniques of finishing gasolines for maximum gum stability and engine cleanliness. Why not let us help you answer your stability problems more efficiently and at a lower cost?

UOP #5 is one of a number of UOP inhibitors and additives available to the refining industry. If you have a protection or preservation problem for product or transport facilities consult us.

PRODUCTS DEPARTMENT

UOP® UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD, DES PLAINES, ILLINOIS, U. S. A.

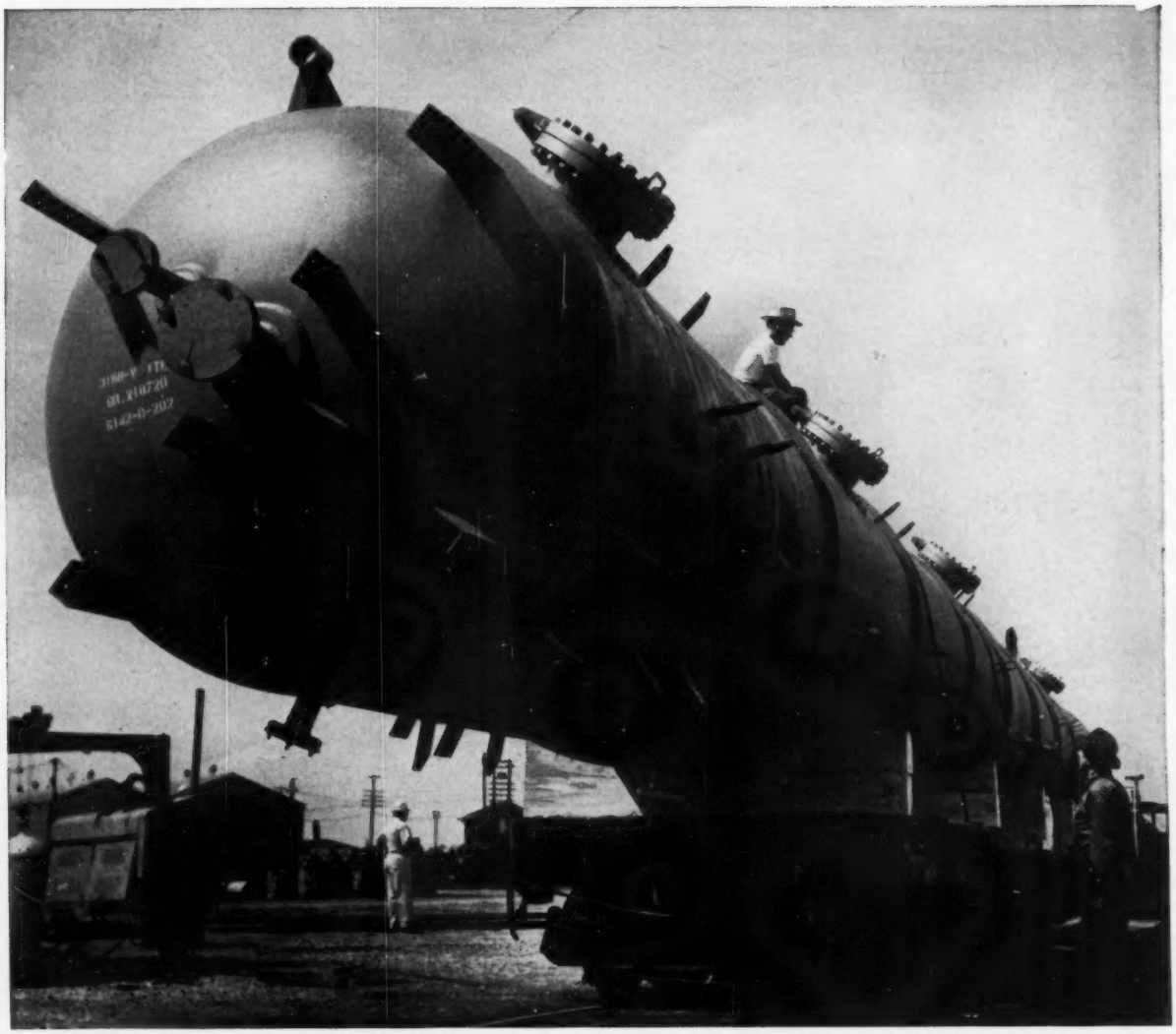
For more data on advertised products, use Readers' Service Cards, last page.

CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Ireland									
Chemstrand	Northern Ireland	*Acrilan Acrylic Fiber Plt.	10,000,000 lbs./yr.	$10,000,000	Engineering	Dec., 1958	.....	Costain John Brown, Ltd., Staff	Costain John Brown, Ltd.
Eire Government Esso Petr. (Ireland) Caltex (Ireland) Irish Shell	Whitegate	Refinery	32,000 bbls.	$33,600,000	Approved	1959	.....	.....	.....
Italy									
Ente Nazionale Idrocarburi	Ravenna	Butadiene Plt.	30,000 tons a yr. Rubber	$75,000,000	Under Constr.	1957	.....	Union Carbide Carbon;	Brown-Root
		Copolymer Plt.	350,000 tons a year		Under Constr.	1957	.....	Phillips Petroleum	Brown-Root
		Ammonia; Fertilizers	.....	.....	.....	1957	.....	.....	.....
Golfo Industria Petrolifera, A.P.A.	Gaeta, Italy	New Refinery	15,000 bbls.	.....	.....	.....	.....	Tecnider	.....
Mobil Oil Italiana S. pa.a	Naples	Cat. Reforming	.....	.....	Pre-engineering	Jan., 1958	.....	.....	.....
		Cat. Hydrodesulfurization	.....	.....	Pre-engineering	.....	.....	.....	.....
		Lube Expansion	.....	.....	Pre-engineering	.....	.....	.....	.....
Purfina Italiana	Milan	Distillation Unit	6,000 bbls.	.....	Complete	.....	.....	Staff	Sarbori & Others
Raffineria Siciliana Oli Minerali (RASIOM)	Augusta	Powerformer	7,500 bbls.	$2,000,000	Under Constr.	Oct., 1957	Esso	CTIP	Bonaldi-Crema
Shell Italiana	Palermo	Refinery	20,000 bbls.	.....	Planning	.....	.....	.....	.....
Soc. Solvay & Cie	Italy	Polyethylene	.....	.....	Licensed	.....	Phillips	.....	.....
S.P.A. Recnico Industriale Aquila	Trieste	Cat. Cracking	3,300 bbls.	.....	Complete	.....	Soc.-Vac.	Staff	Staff
		Cat. Poly.	1,400 bbls.	.....	Complete	.....	UOP	Staff	Staff
STANIC Industria Petrolifera	Bari	Powerformer	7,300 bbls.	$3,400,000	Under Constr.	July, 1957	Esso	CTIP	.....
		*Hydrofiner	8,200 bbls.	$850,000	Engineering	April, 1958	Esso	.....	.....
	Liverno	*Hydrofiner	10,000 bbls.	$1,000,000	Engineering	April, 1958	Esso	.....	.....
Netherlands									
Caltex Petroleum	Pernis	Platformer	7,000 bbls.	.....	Under Constr.	1957	UOP	Lummus, Ltd.	Lummus-Werkspoor
		Diesel Unifiner	4,000 bbls.	.....	Under Constr.	1957	UOP, Union	Lummus, Ltd., Parsons	Lummus-Werkspoor
Esso Nederland	Rotterdam	Refinery	40,000 bbls.	$29,000,000	Planning	Early 1960	.....	.....	.....
Mekog	Velsen-Ymuiden	Nitrogen Fertilizer	.....	$9,000,000	Planning	.....	.....	.....	.....
Nederlandsche Dow Maatschappij N.V.	Rotterdam	Processing Plt.	.....	.....	Under Constr.	.....	.....	.....	.....
N.V. de Bataasfsche Pet. Maatschappij	Pernis	Syn. Glycerine	.....	$7,000,000	Under Constr.	Late 1957	.....	.....	.....
		Platformer	12,700 bbls.	.....	Under Constr.	4th Qtr., 1957	.....	.....	.....
		Hydrodesulfurizer I	16,400 bbls.	.....	Under Constr.	4th Qtr., 1957	.....	.....	.....
		Hydrodesulfurizer II	7,800 bbls.	.....	Under Constr.	4th Qtr., 1957	.....	.....	.....
		Cycle Oil	7,800 bbls.	.....	Under Constr.	4th Qtr., 1957	.....	.....	.....
		Gasoil	16,400 bbls.	.....	Under Constr.	4th Qtr., 1957	.....	.....	.....
Norway									
Standard (N.J.)	Oslo Fjord	Refinery	40,000 bbls.	$29,000,000	Negotiating	.....	.....	.....	.....
Portuguese W. Africa									
Petrofina	Luanda	Refinery	.....	.....	Planning	.....	.....	.....	.....
Scotland									
British Hydrocarbon Chemicals	Grangemouth	Additional Cracking	.....	.....	Complete	.....	.....	S&W Badger Div.	E. B. Badger, Ltd.
		Gas-Separating	.....	.....	Complete	.....	.....	S&W Badger Div.	E. B. Badger, Ltd.
		Ethanol, Ethylene, Tetrapropylene		$13,000,000	Under Constr.	Early 1957	Shell, UOP	S&W Badger Div.	E. B. Badger, Ltd.
		Butadiene	.....	.....	Under Constr.	.....	.....	KIC	KIC
Spain									
British Hydrocarbons	Grangemouth	Polyethylene Plt.	25,000,000 tons/yr.	.....	Engineering	Phillips	.....	.....	.....
Rafineria de Petroleos de Escombreras S.A.	Escombreras	Topping Unit	25,000 bbls.	.....	Under Constr.	1957	.....	Foster Wheeler	Foster Wheeler
		Platformer	11,000 bbls.	.....	Under Constr.	1957	UOP	Foster Wheeler	Foster Wheeler
		LPG Unit Offsite Facil.	.....	$10,000,000	Under Constr.	March, 1957	UOP	Foster Wheeler	Foster Wheeler
Sweden									
Johnson Line	Gothenburg	Refinery	2,500 bbls.	.....	Planned	.....	.....	Staff	Staff
Turkey									
Badische Anilin and Soda Fabrik	Kutefia	Ammonium Sulfate	60,000 tons/yr.	$20,000,000	Planning	1958	.....	.....	.....
		Sulfuric, Nitric Acid	50,000 tons/yr.						
Turkish-American Oil	Istanbul	Refinery; Crude-Vacuum; Cat. Crker., Vapor Recovery, Cat. Poly, Treating	15,000 bbls.	$18,000,000	Approved	Dec., 1958	.....	Kellogg	Kellogg
Turkish Government	Istanbul	Natural Gasoline Plt.	.....	.....	Planning	.....	.....	.....	.....
Union of South Africa									
Union Petrol Refinery, Ltd.	Johannesburg	Refinery	.....	$20,000,000	Projected	.....	.....	.....	.....
NEAR EAST									
Aden									
British Petroleum	Aden	Thermal Reformer	12,000 bbls.	.....	Under Constr.	1958	.....	KIC	Bechtel
Bahrain									
Bahrain Petroleum	Bahrain	Platformer	10,000 bbls.	.....	Under Constr.	1957	UOP	Foster Wheeler	Foster Wheeler
Iran									
National Iranian Oil Co.	Kermanshah	*Refinery Exp.	17,000 bbls.	.....	Engineering	.....	.....	Costain-John Brown, Ltd.	.....
Iraq									
Iraq Government	Iraq	Lube Oil Plt.	25,000 tons/yr.	.....	Planning	.....	.....	Foster Wheeler	Foster Wheeler
Jordan									
Iraq Government	Daura	Refinery Expansion	50,000 bbls.	$10,000,000	Planning	Late 1958	.....	.....	.....
Jordanian Reconstruction Council	Mafrak	Refinery	.....	$7,500,000	Planned	.....	.....	.....	.....
Kuwait									
Kuwait Oil	Mina alAhmadi	Two Distillation Units	80,000 bbls. each	.....	Under Constr.	End 1957	.....	S&W Badger Div., E. B. Badger; Bechtel	Bechtel
Saudi Arabia									
Arabian American Oil Co.	Ras Tanura	Asphalt Plt.	1,250 bbls.	.....	Under Constr.	.....	.....	.....	.....
		Hydrofiner	15,000 bbls.	$4,100,000	Under Constr.	Spring, 1957	Esso	Lummus	Lummus
Standard-Vacuum	Durban, South Africa	*Refinery Exp.	25,000 bbls.	$9,000,000	Engineering	.....	.....	Foster Wheeler	Foster Wheeler
		*Powerformer	.....	.....	.....	.....	.....	.....	.....
		*Hydrofiner	.....	.....	.....	.....	.....	.....	.....
		*Steam Plt.	.....	.....	.....	.....	.....	.....	.....
Saudi Arabian Government	Saudi Arabia	Ammonium Sulfate Plt.	400,000 Metric tons/yr. Plus 500 Tons Dry Ice	.....	Proposed	.....	.....	.....	.....

* First appearance in tabulation

Construction BOXSCORE Continued on Page 263



THIS ENTIRE VESSEL was radiographed. Built for use by Socony Mobil Oil Company, Incorporated, it was stress relieved in thirds, and the two joints were stress relieved locally. The unit contains 30 uniflex trays of 96" diameter. Overall weight: 152,000 lbs.

Among the largest in use

...built by Newport News

This Debutanizer with a 110 feet 6 inches over-all length is typical of units that are readily built by Newport News . . .

In fact, Newport News can fabricate almost any type of pressure vessel or other heavy equipment used in the petroleum, chemical or other processing industries.

But at Newport News you'll find more than large productive capacity.

In vast fabricating shops, in huge machine shops, foundries and forging plants, Newport News craftsmen complete your order with specialized techniques. Plant methods . . . developed as a result of specializing for more than half a century . . . enable Newport News to provide money-saving answers to all sorts of heavy equipment problems.

Newport News craftsmen handle the job exactly as you want it done . . . for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and Products"...it's yours for the asking.

Engineers — Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

Newport News Shipbuilding and Dry Dock Company
Newport News, Virginia

CONSTRUCTION BOXSCORE—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Syria									
Esso Standard	Syria	Refinery	10,000 bbls.		Proposed				
Syrian Government	Homs	Refinery	20,000 bbls.	$11,000,000	Considering				
FAR EAST									
Burma									
Burmah Oil	Syriam	Refinery			Under Constr.				
	Chauk	Auxiliary Fac.			Under Constr.				
Ceylon									
Shell of Ceylon	Hendola	Refinery		$40,000,000	Planning				
India									
Assam Oil	Assam	Refinery			Considering				
Caltex Oil Refining (India) Ltd.	Visakhapatnam	Refinery	13,500 bbls.		Under Constr.	Early 1957		Lummus; Foster Wheeler	Lummus; CB&I
Dow et al	Bombay	Polystyrene Plt.	2,700 ton/yr.		Under Constr.	Spring, 1957		Bechtel	Bechtel
Indian Government	Bhavnagar	Refinery	30,000 bbls.	$42,000,000	Considering				
	India	Synthetic Pet. Plt.	6,000 lbs.		Planning				
Japan									
Asahi Chem. Co., Ltd.	Nobeka	*Ammonia Plt.			Engineering			Chemco	Chemco
Daikyo Oil	Yokkaichi	Houdriformer	3,000 bbls.		Under Constr.	Late 1957	Houdry	Treco	Staff
Idemitsu Kosan Co.	Tokuyama	Refinery	30,000 bbls.	$25,000,000	Under Constr.	June, 1957	UOP;J.G.C.		
Maruzen Oil Co.	Japan	Petrochemicals			Unconfirmed				
Mitsui Petrochemical Industries	Iwakuni City	Ethylene Oxide, Ethylene Glycol		$30,000,000	Under Constr.	Nov., 1957	SDC	S&W Badger Div.	
		Ethylene Unit			Engineering	1957		S&W	S&W
		Phenol Unit			Engineering	1957		Distillers, Ltd.	S&W
Mitsubishi Oil Co., Ltd.	Kawasaki	Crude Unit	25,000 bbls.		Under Constr.	1957		Chitida	Chiyoda
		Crude Desalter	25,000 bbls.		Engineering	1957		Petreco	Chiyoda
		Copper Sweetener	3,500 bbls.		Engineering	1957		Union Carbide	Chiyoda
		Platformer	3,000 bbls.	$13,700,000	Engineering	1957	UOP	UOP	Chiyoda
		Unifiner	12,500 bbls.		Engineering	1957	UOP	UOP	Chiyoda
		Udex	750 bbls.		Engineering	1957	UOP	UOP	Chiyoda
Mitsubishi Petrochemical Co.	Yokkichi	*Ethylene; Styrene Monomer; Ethylene							
		*Oxide: Ethylene Glycol, Polyethylene		$35,000,000	Engineering	1958			
Nihon Gas Kagaku Kogyo	Niigata	Urea	905 tons			Spring, 1957		Chemico	Chemico
		Ammonia	100 tons	$2,100,000	Engineering	Spring, 1957		Chemico	Chemico
		Ammonia Sulfate	200 tons			Late 1957		Chemico	Chemico
Nippon Oil Co.	Niigata	*Platformer	1,600 bbls.	$1,890,000	Engineering	1958	UOP	UOP; Japan Gasoline	
		*Topping Unit	7,500 bbls.		Complete			Staff	
Nippon Petroleum Refining	Yokahoma	Unifiner-Platformer	3,300 bbls.	$2,500,000	Under Constr.	Sept., 1957	UOP	UOP; Japan Gasoline	
Nippon Petrochemicals	Kawasaki	Isopropyl Alcohol; Acetone	2,000 tons/yr. 3,500 tons/yr.	$33,000,000	Under Constr.	June, 1957	Distillers, Ltd.	S&W Badger Div.	
		*Ethylene	25,000 tons/yr.		Planning	1959	Esso	S & W Badger Div.	
		Butadiene	5,000 tons/yr.						
Showa Oil Co.	Yokkaichi	Refinery	40,000 bbls.		Under Constr.	Dec., 1957			
Sunitomo Chemical	Japan	Ethylene Unit			Engineering	1957		S&W Badger Div.	
Korea									
Korean Government	Chung-ju	Urea Plt.	185 tons	$25,000,000	Under Constr.	1958	Vulcan, Inventa, Texaco, Hydrocarbon	Hydrocarbon, McGraw Vulcan	Hydrocarbon, McGraw
Sumatra									
Standard-Vacuum	Palembang	Cat. Cracker	11,000 bbls.					Foster Wheeler	Foster Wheeler
		Polymerization	1,200 bbls.	$20,000,000	Planning			Foster Wheeler	Foster Wheeler
		Revamp Existing Plt.						Foster Wheeler	Foster Wheeler
Formosa									
Taiwan Fertilizer, Ltd.	Nankong	Ammonia Plt to Produce Urea	260 tons	$18,000,000	Under Constr.	Spring, 1957	Vulcan, Inventa	Hydrocarbon Vulcan	Staff
AUSTRALASIA									
Australia									
Bitumen & Oil Refineries	Queensland	Crude Unit	5,000 bbls.		Complete	1957			
		Platformer	1,500 bbls.		Complete	1957			
		Desulfurization	1,500 bbls.		Complete	1957			
	Sydney	*Platformer			Under Constr.	1957		UOP	Local
		*Unifiner			Under Constr.	1957		UOP	Local
Philippine Islands									
Shell (Philippines)	Manila	Refinery			Negotiating				
Standard-Vacuum	Manila	Refinery	21,000 bbls.	$35,000,000	Planning				

* First appearance in tabulation.

NOTE:
Armistead—George Armistead & Co.
Atlantic—Atlantic Ref. Co.
Austin—Austin Co.
Badger Mfg.—Badger Manufacturing Co.
Badger N. V.—Badger-Comprimo N. V.
E. B. Badger Ltd.—E. B. Badger & Sons Ltd.
E. B. Badger Pty.—E. B. Badger & Sons Pty., Ltd.
Barnes—W. M. Barnes Co.
Bechtel—Bechtel Corp.
Beck—Henry C. Beck
Blaw-Knox—Blaw-Knox Co.
Braun—C. F. Braun Co.
Breda—Breda Electromaconia Locomotive
Brown & Root—Brown & Root Construction Co.
Buckner—F. J. Buckner Corp.
Calif. Res.—California Research Corp.
Can. Kellogg—Canadian Kellogg Co.
Cat. Constr.—Catalytic Construction Co.
Chemico—Chemical Construction Co.
Ch. Pro.—Chemical Process, Inc.
C. B. & I.—Chicago Bridge & Iron Co.
Chiyoda—Chiyoda Chemical Engineering & Contruction Co., Ltd.
C. & I.—Chemical & Industrial Corp.
Consd. Eng.—Consolidated Engineering Company
Craig—A. F. Craig & Co.
C.T.I.P.—Compagnia Tecnica Industria Petroli
D & Z—Day & Zimmerman
Delta—Delta Engineering Corp.
Dresser—Dresser Engineering Corp.
Ebasco—Ebasco Services Inc.
E&A—Ehrhart & Associates, Inc.
Esso—Esso Research and Engineering Co.
Edeleanu—Edeleanu Gesellschaft M.B. H.
Etabadger S.A.—Etablissement Badger, S.A.
F&C—Farnsworth & Chambers Co., Inc.
Ferguson—H. K. Ferguson Co.
Fish—The Fish Engineering Corp.
Fluor—Fluor Corp.
Ford, Bacon, Davis—Ford Bacon & Davis Construction Corp.
Foster Wheeler—Foster Wheeler Corp.
Gas Plant Constr.—Gasoline Plant Const. Corp.
Girdler—The Girdler Co.
Girdler (Canada)—Girdler Corp. of Canada, Ltd.
Graff—Graff Engineering & Equipment
Graver—Graver Construction Co.
Grebe & Doremus—Grebe & Doremus Process Co.
Gutte-Hutte—Gutehoffnungshuette
Hedrick—Wyatt C. Hedrick Engineering Corp.
Hercules—Hercules Powder Co.
Hudson—Hudson Engineering Corp.
H&G—Humphreys & Glasgow, Ltd.
H.W.P.—Head Wrightson Process, Ltd.
Hydrocarbon—Hydrocarbon Research, Inc.
Hydro M—Hydrocarbon Mineraloel G.m.b.H.
Hydro E—Hydrocarbon Engineering S.A.R.L.
Kaiser—Kaiser Engineers
Kellogg—The M. W. Kellogg Co.
Kellogg P. A.—Kellogg Pan American
KIC—Kellogg International Corp.
Kidde—Walter Kidde Engineers Southwest, Inc.
Koch—Koch Engineering Company
Koppers—Koppers Co., Inc.
Litwin—Litwin Engineering Co.
Lummus—The Lummus Co.
Macco—Macco Corp.
Mannix Gill—Mannix Gill, Ltd.
McGraw—F. H. McGraw & Co.
McKee—Arthur G. McKee Co.
M-C.& S—Merritt-Chapman & Scott Corp.
Olsen—O. L. Olsen
P. A. HydroRes—Pan-American Hydrocarbon Research Co.
Parker—Parker, Steffens & Pearce
Parsons—The Ralph M. Parsons Co.
Petroco—Petroleum Construction Co.
Phillips—Phillips Petroleum Co.
Power Gas—Power Gas Corp., Ltd.
Pritchard—J. H. Pritchard Co.
Procon—Procon, Inc.
Quaker—Quaker Valley Constructors
Russell—Russell Engineering Corp.
Rust—Rust Engr. Co.
SBA—Soc. Bedge de L'Azote et des Produits Chimiques du Hardy
SDC—Scientific Design Co.
S & B—Slingmaster & Breyer Separator-Nobel Co.
Soc. Mob.—Socony-Mobil Oil Co.
Southwestern—Southwestern Constr. Co.
Sohio—Standard Oil Co. of Ohio
Stearns-Roger—Stearns-Roger Mfg. Co.
Sunland—Sunland Refining Co.
S & W Badger Div.—Stone & Webster Engineering Corp. Badger Process Div.
S & W Canada Ltd.—Stone & Webster Canada Ltd.
Swco—Southwestern Engineering Co.
Tears—Tears Engineers
Tellepsen—Tellepsen Petro-Chem Constructors
Texaco—The Texas Co.
Texas Natural—Texas Natural Gasoline Corp.
Treco—Refinery Engineering Co.
Tuloma—Tuloma Builders
U.O.P.—Universal Oil Products Co.
Vulcan—Vulcan Engineering Div.
J. G. White—J. G. White Eng. Corp.

The appraisal method . . .

Developing Leaders for Management

The appraisal of management people at all levels is a prerequisite for a sound development program. Whatever the extent of the evaluation, it will build a backlog of managerial material and raise the quality in present positions.

David F. Tver
Director, Industrial Relations Department
Anderson-Prichard Oil Corporation
Oklahoma City

ONE OF THE MORE specific techniques developed for the selection of executive and management people has been the individual method of appraisal, training and development. These programs vary by company in relation to extent, scope and levels to be included.

Some companies confine the program of executive and management development to the first two or three levels of management. Others carry the program to the lowest recognized management level.

The concept of appraising management people at all levels is in accordance with the objectives of a sound development program. These objectives are to (a) assist management people to function more effectively in their present jobs, (b) to build an adequate managerial reserve.

The effectiveness of the program lies, in the last analysis, in the desire for self-development by the individual, who recognizes and desires it as an aid in the fulfillment of his ambition. The findings of social scientists, psychologists, physicians specializing in industrial medicine, mental and emotional health, all bear out the importance of aiding the manager or executive to broaden his horizons.

Why Excutive Development?

Thomas G. Spates, professor emeritus of personnel administration, Yale University and former vice president of General Foods Corporation, in the American Management Association's December, 1956, issue of *Management Review* summarizes the findings and conclusions that appear relative to executive development of which the men in these various fields appear to be in substantial agreement:

1. A human being does not have a personality; he is a personality, the parts of which are in balance and cannot be independently changed.

2. Almost all the problems with which human beings contend in achieving and maintaining a healthy personality are due to relationships with other personalities.

3. Improving interpersonal relations should be a major goal of all education and development. This is a truly formidable task that involves attitudes, behavior and the skills in human relations that are probably the most difficult to teach and to learn.

4. The most essential step in achieving this formidable task is to known and understand ourselves as a requirement for knowing and under-

A well patterned "Coaching" interview includes the following steps:

- **The warm up—break the ice, state the purpose of the interview, outline the sequence to be followed.**
- **Concentrate on a discussion of the appraisal, preferably with the subordinate appraising himself.**
- **Provide for an analysis of the reasons why certain responsibilities are not being adequately performed.**
- **Canvas the possible ways of improving performance.**
- **Establish a specific plan for improvement.**

No matter how you look at it...

for...

Whatever the GRADE and the VOLUME of

NATURAL GASOLINE

Just rely on WARREN'S versatile facilities to give you dependable deliveries . . . WHERE and WHEN and the WAY you want them.

WARREN

PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

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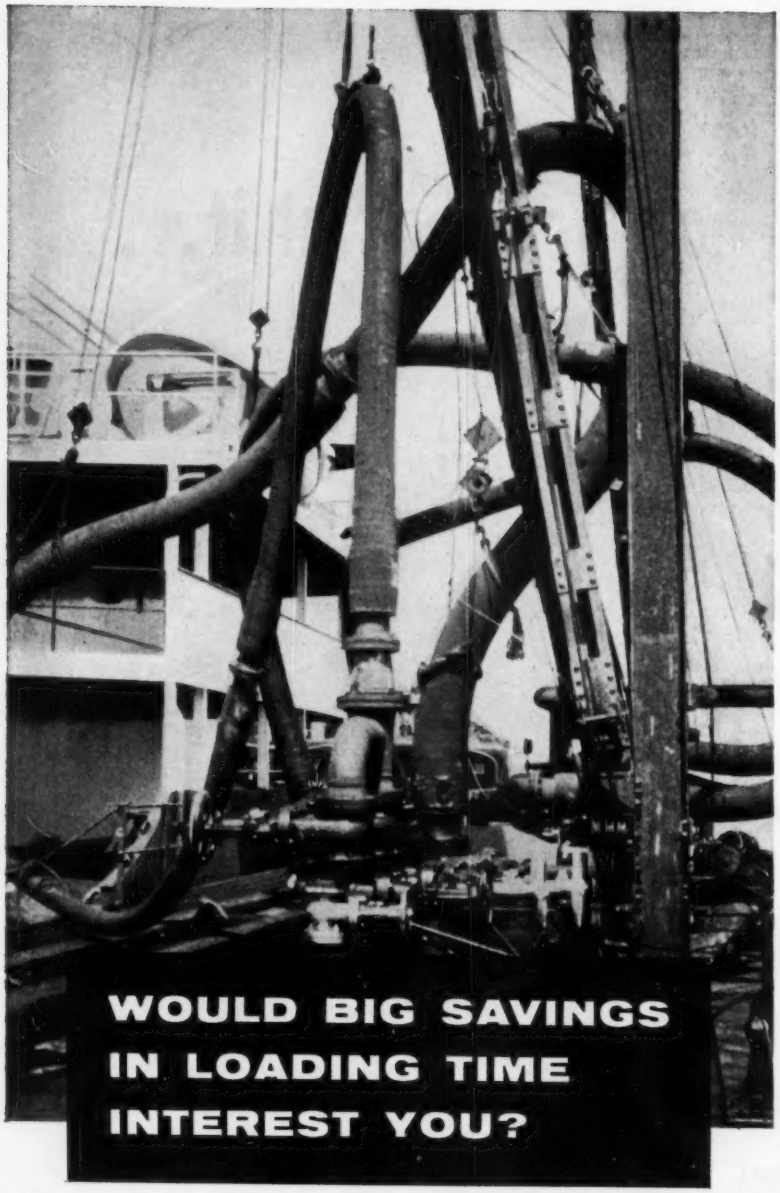


You can save up to 50% of the time required for loading and unloading petroleum products with Hewitt-Robins "Monarch" oil suction and discharge hose. It has a smooth bore that cuts frictional resistance to a minimum and is lighter in weight and easier to handle than rough bore hose.

Because the tube in this super-tough, wire-reinforced hose is permanently bonded to the carcass by a special H-R process, Monarch has replaced competitive rough bore hose in many installations. Fittings are also permanently bonded through the exclusive H-R Durabond process, and cannot pull loose even under severest strain. To find out how H-R products and services can help you, consult your classified telephone directory for the nearest H-R representative, or contact Hewitt-Robins, Stamford, Conn.

HR HEWITT-ROBINS

CONVEYOR BELTING AND IDLERS . . . POWER TRANSMISSION DRIVES
INDUSTRIAL HOSE . . . VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

standing others. This involves self-analysis, self-awareness, and self-development as primary conditions for effective leadership.

5. All genuine learning is essentially personal. It depends upon self-motivation and is derived from the felt needs of the student; it is in the last analysis self-learning; it is largely an emotional experience.

6. Constructive learning involves change and adjustment of attitudes and behavior. This kind of learning is stifled by authority; it requires participation in creating the learning environment and a permissive atmosphere in which participants are free to discuss real problems in which they have a sense of personal involvement. Lectures are useless for this kind of learning.

7. The process of evaluating and feeding back the results and consequences of the learning experience is an essential aspect of methods of improving skills in human relations.

8. Listening with understanding is the gateway to real communication, and it can be an effective means of altering personality structure. Until one tries it, he will never know how very difficult it is and the courage it requires.

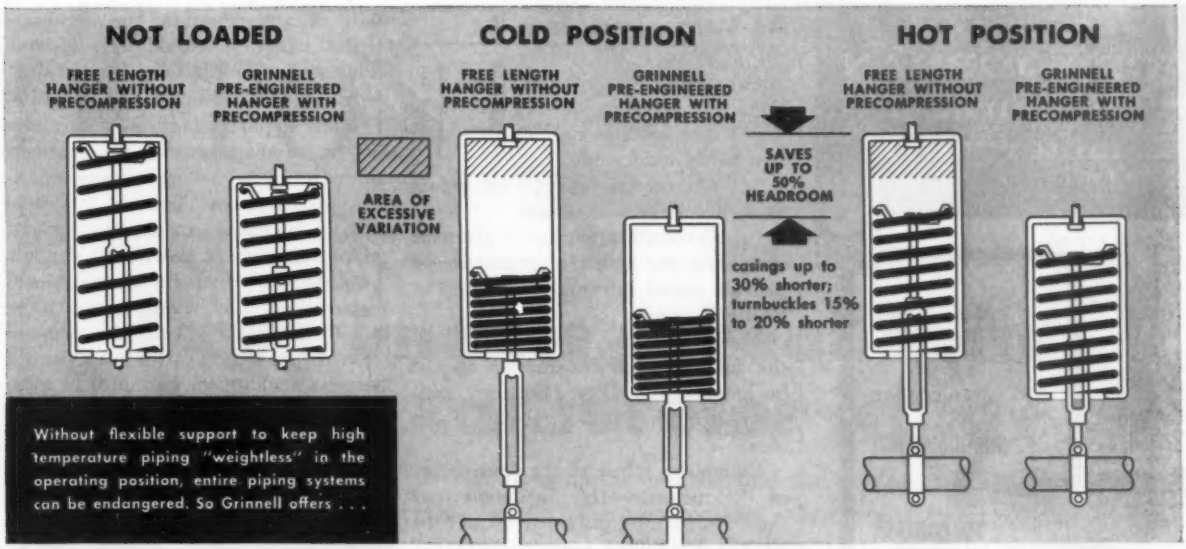
9. One of the most important factors in the moral and productivity of the individual is his mental attitude toward the boss. The best results are achieved by supervisors who place primary emphasis on human problems and contribute to the sense of important and personal worth of those whose work they direct.

The program, by its very nature, must be long ranged. Today's planning is for the organization five or more years hence. Management personnel planning is put on the same business-like basis as capital expenditures and budgets. The management manpower needs are determined and constructive steps are taken towards meeting them.

How to Set Up the Appraisal Method. A study of effective and ineffective appraisal programs over a period of years reveals the following differences between the two:

(a) The objectives are clear, precise and understood.

For more data on advertised products, use Readers' Service Cards, last page.


NOT LOADED
COLD POSITION
HOT POSITION
FREE LENGTH HANGER WITHOUT PRECOMPRESSION
GRINNELL PRE-ENGINEERED HANGER WITH PRECOMPRESSION
AREA OF EXCESSIVE VARIATION
FREE LENGTH HANGER WITHOUT PRECOMPRESSION
GRINNELL PRE-ENGINEERED HANGER WITH PRECOMPRESSION
SAVES UP TO 50% HEADROOM
casings up to 30% shorter; turnbuckles 15% to 20% shorter
FREE LENGTH HANGER WITHOUT PRECOMPRESSION
GRINNELL PRE-ENGINEERED HANGER WITH PRECOMPRESSION
Without flexible support to keep high temperature piping "weightless" in the operating position, entire piping systems can be endangered. So Grinnell offers . . .

Precompressed Hangers for Safer Support of Piping

Helical coil springs are widely used in hangers for flexible support of piping which moves up or down during thermal expansion. The A.S.A. code for pressure piping requires that variable spring hangers support at least a minimum of 75% of the pipe's weight for a pipe that rises (relaxing the spring) and no more than 125% of the pipe's weight for a pipe that lowers (compressing the spring) during operation.

Precompression patented Grinnell principle

To guard against the spring's supporting force exceeding the limits of variation, Grinnell developed and patented a variable spring hanger design. The steel casing holds the spring permanently precompressed, at the threshold of the hanger's working load range. This prevents the spring decompressing into its area of excessive variation.

Pre-set is not a substitute

As a partial substitute for this patented precompression, some manufacturers insert a spacer between the top end of a free-length hanger casing and the spring to hold the spring's height temporarily within the working range during shipment and erection.

Another device requires the manufacturer to drill symmetrically opposite holes in the casing walls and insert a bolt to hold the spring's height within the working range. When these devices are removed from the hanger and discarded, the spring can decompress, resulting in high variability in supporting force.

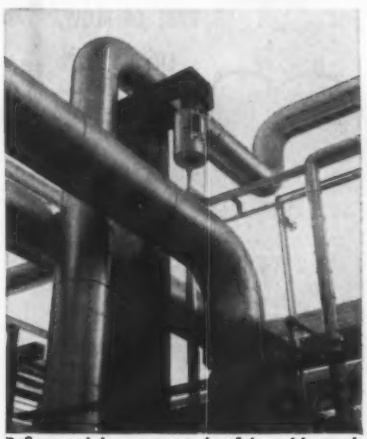
Cold-setting a universal factory service

For the erection crew to avoid having to compress the spring down to the erected position, the manufacturer can compress the spring down to this height. Grinnell can provide a cold-set bolt in precompressed hangers.

Less headroom required by Grinnell Hangers

Shorter hanger casings made possible by Grinnell's patented precompression, reduce bulk shipping weight and required headroom by eliminating undesirable height. Installation is simplified by this shorter casing and also by an integral load scale with load indicator.

Additional headroom is saved by a correspondingly shorter turnbuckle. These precompression advantages are available in short spring and double spring models as well as standard spring models.



Refinery piping supported safely, with ample flexibility but low headroom.

Available in 63 standard units

Grinnell Variable Spring Hangers are available in 21 sizes each of short, standard and double spring models . . . for maximum travel of 1¼, 2½ and 5 inches respectively within working load ranges. Load capacities extend from 43 lbs to 30,550 lbs. The maximum variation in the standard size per ½-inch deflection is 10½% of rated capacity; inversely proportional in short spring and double spring models.

For further information

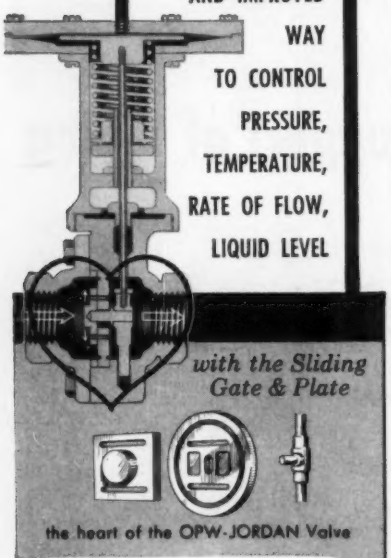
If you have a pipe suspension problem, you are invited to write: — Grinnell Company, Inc., 282 West Exchange Street, Providence, R. I.

For more data on advertised products, use Readers' Service Cards, last page.

OPW-JORDAN
diaphragm
motor valve

No. 170

THE DIFFERENT
AND IMPROVED
WAY
TO CONTROL
PRESSURE,
TEMPERATURE,
RATE OF FLOW,
LIQUID LEVEL



with the Sliding Gate & Plate

the heart of the OPW-JORDAN Valve

- POSITIVE, DEAD END SHUT-OFF
- PRECISE, ACCURATE CONTROL
- WIDE RANGEABILITY
- SELF CONTAINED OR CONTROLLER OPERATED

The No. 170 Diaphragm Motor Valve, incorporating the use of OPW-Jordan's unique Sliding Gate, offers straight through flow, with modulation through the valve opening. Seating surfaces of hardened stainless steel, precision lapped to light band flatness tolerances insure a positive leakproof shut-off. Wire drawing minimized or eliminated. Compact, space-saving, the No. 170 offers the full advantage of accurate control and desired sensitivity. Durably constructed for hard continuous usage, the basic design and exclusive features of this valve make it outlast and outperform ordinary diaphragm motor control valves.

Free Bulletin J-170 gives complete details, flow curve and capacity tables.

OPW

JORDAN CORPORATION
DIVISION OF OPW CORP.
6013 Wiehe Road
Cincinnati 13, Ohio
ELmhurst 1-1352

As Management Sees It . . .

(b) Sound performance information is obtained.

(c) The information is wisely and frequently used.

(d) Continuous efforts are made to secure improved results.

(e) Constant attention is given to increasing the ability of executives to provide sound information as well as to use it wisely.

There are four criteria by which the soundness of information should be judged: reliability, relevancy, representativeness and freedom from bias.

Reliability refers to the consistency of the measure—the likelihood that the information obtained would be similar if obtained again.

Relevancy refers to the pertinence of the information to the position under consideration.

Representativeness refers to the degree to which the information actually represents the entire performance under review.

Freedom from bias takes into account the tendency for conscious and unconscious bias—the nemesis of appraisal plans—to creep into evaluations.

In relation to any program, such as management development, there is a tendency sometimes to become so enmeshed in developing the program that limited progress is made in developing executives. A company that is well run normally will produce good executives, just as a healthy family produces good children. That type of development takes place without any special effort; the program itself basically increases or intensifies the rate of growth, so that they are ready for top positions at an age when they can contribute maximum service.

Executive appraisal programs will vary according to each company's specific desires and needs. However, there are four areas normally common to all programs:

1. Determining organization needs.
2. Appraising personnel.
3. Post appraisal counseling.
4. Planning individual development.

Management development programs of today normally contain one or more phases of these elements:

1. **Determining Organization Needs.** To determine the what, where and why of any program, the organizational structure should be reviewed. This step establishes the basic framework for the balance of the program.

Each departmental unit normally starts its management development activities by reviewing its own organization structure. This is a logical lead-in to management development planning, since it indentifies the key positions for which replacements will be required. This would appear to be a routine step if it could be assumed that organization structures would remain unchanged, but since in most organizations this is rarely the case, each unit should be periodically analyzed to determine whether any organization changes should be planned.

Many reasons may indicate that change is desirable. Job responsibilities often need to be redefined. The pending retirement or the personal weakness of an individual in a key spot may suggest a realignment of responsibilities. The evolution of the business may make necessary the splitting up of jobs that have become too big, or the consolidation of functions that appear likely to dwindle in significance. Often faulty performance gives evidence of a need for change. Reorganization may be the route to improved efficiency. Where a study of an organization unit indicates that changes are warranted, the unit prepares an additional or proposed organization chart to accompany its present chart. The proposed chart in most cases represents the ideal or long-range goal toward which the unit is working.

2. **The evaluation and Preparation of Position Descriptions For Each Managerial Position.** "A list of responsibilities may limit what a man does," is sometimes heard from those who oppose written clarification of jobs. In fact, some executives argue that you can't really describe a complex job. Nevertheless, by whatever process, each individual has to arrive at some determination of what is expected of him, they are more likely to be restrictive in their activities than otherwise. Clear and sound organization structure is important in creating an atmosphere that stimulates executive growth.

Executives develop best when they know what they are doing and where they can go. With a soundly developed and clearly defined plan of organization which describes each po-

For more data on advertised products, use Readers' Service Cards, last page.

DU PONT *Petroleum Chemicals* NEWS

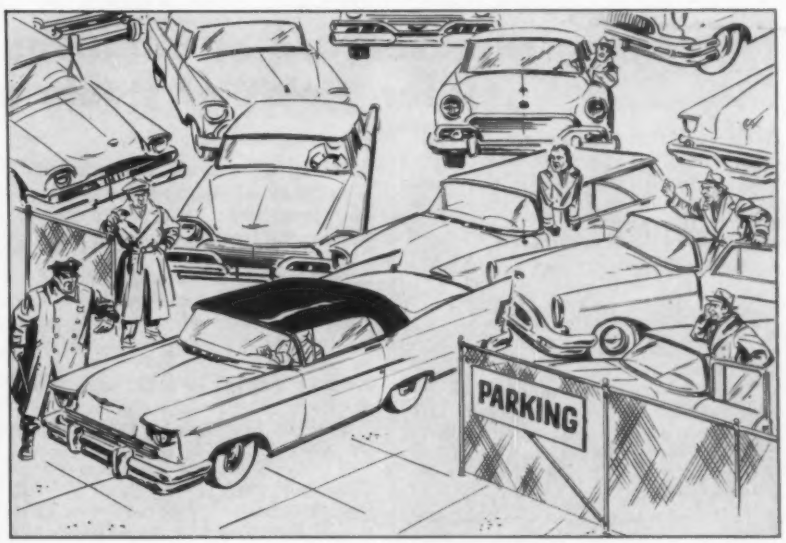
One of a Series of Bulletins for the Petroleum Industry

APRIL 1957

Experiments reveal facts about carburetor icing

Recent experiments indicate that stalling due to carburetor icing occurs even in 55-degree weather. Moreover, they prove that Du Pont DMF (dimethyl formamide) provides the motorist with protection against this type of hazard and annoyance.

Stall-prevention is especially important in many cars having power brakes and power steering—both of which are less effective when the car-engine stops.



STALLS DUE TO carburetor icing often happen at the most inconvenient times, such as the rush-hour traffic jam in the parking lot above—caused by the stalled car at the exit gate. Our growing traffic congestion especially points up the need for eliminating situations like this. When Du Pont DMF is added to gasoline, it effectively prevents carburetor icing stalls which occur under a wide range of temperature and humidity conditions.

Dimethyl formamide proved effective in low concentrations

Its practical use concentration turned out to be under 0.10 volume per cent—in other words, less than three milliliters per gallon!

Long stalling season

Conditions under which your customers' cars can stall also became clearer. The "refrigerant" action of gasoline can lower the temperature of carburetor parts to freezing even on comparatively warm days. Generally speaking, temperatures from 22 to 55 degrees Fahrenheit can lead to carburetor icing when humidity is 65 per cent or higher.

Expanding de-icer market

Motorists are showing an ever-increasing interest in gasoline performance. By anticipating a greater demand next fall for gasolines which contain anti-stalling agents, you can increase the

GENERAL MANAGER ORGANIC CHEMICALS DEPARTMENT

SAMUEL G. BAKER began his career in 1923 on a dynamite production line at the Du Pont explosives plant in Washington. Six months later, he left the company to resume his university career.

After graduating in chemical engineering from the University of Washington, Mr. Baker returned to Du Pont

in 1925 as a chemist at the Eastern Laboratory and the Repauno Works in Gibbstown, New Jersey. In 1939, he was named Director of Sales of High Explosives Manufacturing Division. Four years later, Mr. Baker joined the Electrochemicals Department, where he became General Manager in 1948.

He became General Manager of the Photo Products Department in 1950. The Organic Chemicals Department is the third department Mr. Baker has headed. He was appointed General Manager of that department late last year.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DUPONT *Petroleum Chemicals* NEWS

New Du Pont engine assembly demonstrates carburetor icing

MARKETER:
So this is the apparatus you use to demonstrate carburetor-icing characteristics of gasolines?

DU PONT REPRESENTATIVE:
Yes, it consists of a 1.6-horsepower engine connected to a small ice tower by a glass tube manifold.

MARKETER:
I see there's a build-up of ice on the little metal throttle plate in the tube . . .

DU PONT REPRESENTATIVE:
That's right. The fuel being tested contains no anti-icing additive – see, the engine just stalled! Now watch it take hold again when the DMF is added.

MARKETER:
Say, this unit would come in handy at our next dealer meeting . . .

DU PONT REPRESENTATIVE:
We'll help you build one. You'll find it very convincing for selling dealers and customers on your new NO-STALL GASOLINE with DMF.

Increased use of additives leads to greater yields of stable products

When insoluble residues form in distillate fuels, it usually means trouble for the user – and often for the supplier. Maintaining fuel stability is the key to solving this problem. And, in most cases, the use of additives has been found to be the most economical solution.

The trouble and the cure

Residue formation is more of a problem today than ever before because of the increased use of catalytically cracked stocks. Although cat-cracked stocks are as good as straight-run stocks in heating value, they are generally less stable in storage. As a result, users experience troubles caused by sludge.

In the case of domestic heating oils, for example, unstable stocks can lead to plugging of filters, nozzles and other parts. Du Pont Fuel Oil Additive No. 2 (FOA-2), a stabilizer and dispersant, inhibits the formation of those sediments.

Diesel fuels improved with FOA-2

Users of diesel fuels also encounter stability problems. The formation of insoluble residues in cat-cracked stocks can lead to injector-sticking, build-up of undesirable deposits in combustion chambers and loss in engine performance. Diesel fuel refiners are discovering that these problems, too, can often be overcome by the addition of Du Pont FOA-2 to their cat-cracked stocks.

FOA-2 is ideally suited for stabilizing all types of fuel oils. A small amount will not only prevent formation of residues, but will disperse them as well. Thus it tends to rid oil-feed systems of any sludge that may have previously formed.

Technical paper available

As the need for greater fuel stability grows, you will be looking for the most economical way of obtaining it. In a technical paper entitled "Improving Fuel Oils through the Use of Additives," W. deB. Bertolette and J. D. Rogers describe additive treating as a relatively simple operating procedure and point out how economical it is compared to refining or other treating processes.

To get your free copy of this paper, just send your request to any of our sales offices listed on this page.

CONTINUED

Carburetor Icing

number of your cold-weather customers. Now is the time to anticipate the day when temperatures begin dropping below 55 and carburetor icing begins.

Economy and reduced storage

DMF offers two important benefits – economy and minimum storage-space requirement. The low volume concentration that's needed represents a real saving in freight and blending costs. And, because of the high efficiency of Du Pont DMF, and the low concentration required, little storage space is necessary.

See the "demonstration" of DMF, top of page.

A Du Pont Petroleum Chemicals Division representative will be glad to give you more detailed information on DMF. You can contact him at any of our sales offices listed at right.

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OVER

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sition by listing its major duties and spelling out the authority of the individual who holds it and his relationship with other executives, ambitious understudies know the nature of the job ahead and can better equip themselves to handle it.

3. **Psychological Testing.** To determine the candidate's interest, temperament, alertness, knowledge of supervision and any other special areas desired to be evaluated. Tests, if used correctly, are used only as an exploratory tool and as a reference point. They decide nothing in themselves, but help confirm conclusions of the appraisal panel and thus provide greater confidence in their conclusions.

4. **Completion of a Questionnaire by the Candidate For Use in the Appraisal Session.** This would include a statement by the candidate stating his ambitions, his specific needs, the area in which he believes he needs help and the contribution that his development would make toward the attainment of company objectives and to his personal satisfaction and growth.

5. **Management Appraisal.** Various appraisal methods have been developed over the years. Each one seems to improve on the other. One of the most frequent seen presently is what can be called the "trait-rating method." The number of traits vary from 6 to as many as 15 or 20. The degrees of the traits may be described in very general terms or in elaborate detail. Another popular method involves the appraisal of such general factors as results, methods, personal qualifications, ambition and potential. These factors are usually appraised in narrative form.

While such plans have their limitations, they nevertheless represent a real improvement over informal appraisals. However, the limitations of these types of plans should be recognized to avoid the common pitfalls.

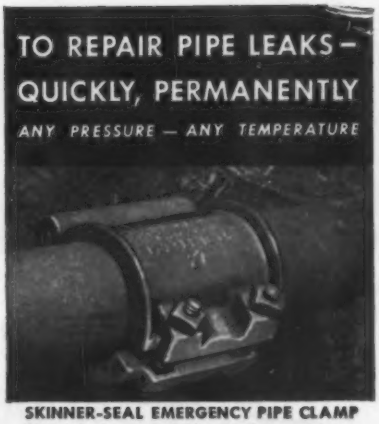
When post appraisal discussions are held, although the discussion of the traits does contribute in letting the individual know how he is doing, if too much attention is given trait evaluation, the subordinate will still lack a clear picture of what and where he must improve or how he should go about it. Other weaknesses are the reliance on general terms such as poor and average, and the use of too large a number of traits although research has shown that only a few basic factors account for difference in performance.

6. **Post Appraisal Counseling.** As we have seen, the generally recommended technique for putting appraisal information to use is that of coaching by the immediate supervisor. The appraisal as a whole is well adapted to a patterned coaching interview. Step 1, the warm-up breaks the ice, states the purpose of the interview, and outlines the sequence to be followed. Step 2 concentrates on a discussion of the appraisal, in the course of which preferably the subordinate appraises himself. Step 3 provides for an analysis of the reasons why certain responsibilities are not being adequately performed. Step 4 canvasses the various possible ways of improving performance. In Step 5 a specific plan for improvement is established.

If these coaching steps are carried out, the essentials of development will be met. The employe will have a much clearer idea of what constitutes a "job well done." He will know how he is doing and a plan of development will be tailored to his needs.

7. **Continuous Counseling In Areas to be Strengthened or Improved.** This is one of the most important phases of executive development inasmuch as it makes the candidate feel he is being given adequate consideration. When the superior has put his finger on a specific weakness and demonstrated not only his willingness to assist in effective improvement, but that improvement is expected within a reasonable time, the manager is put in competition with himself. It is also possible, that, through the exchange of discussion over a period, these intellectual conditioning phases will create an atmosphere in which it will become less difficult for the superior to talk frankly with his subordinates.

8. **Company Education.** This includes training positions, rotational assignments, meetings, over-all training courses on principles of management and human relations, publications, etc. In rotational assignments, executives have reaped dividends from the courage of their decisions to put a man with the basic personal qualification into an important position for which he does not have adequate experience. This technique has pro-



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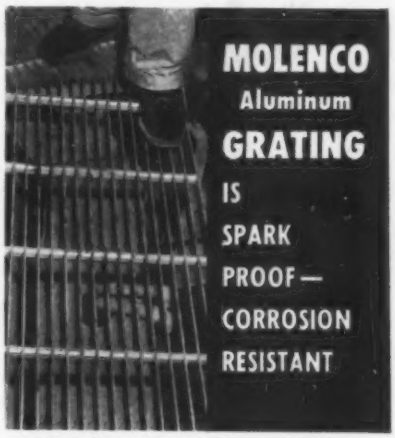

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As Management Sees It . . .

duced excellent results where it has been consistently and wisely used. One danger is that of rotating too fast from job to job. If they are rotated at too accelerated speed, it will leave them no sense of accomplishment in any one post along the way. It is commonly known as "suitcase supervision."

Another useful technique is the training of assistants. Present management is strengthened because the assistant is always available in the absence of the superior; future management is strengthened by the training that the assistant receives through participation in decisions and through feeling the full weight of responsibility when performing the job of his superior.

9. **Outside Education.** Management courses, short courses, special seminars, evening courses and evaluation of the courses.

One of the important by-products of a development program of this nature is that every manager is made to understand that the development of his immediate subordinates is an important, if not one of the most important responsibilities of his job. Rather than a haphazard chore, it should become a systemized daily function. Instead of analyzing the strengths and weaknesses of subordinates only when promotions are imminent or difficulties arise, this assessment becomes a continuous process.

What Is Expected of the Counselor? It is realized that counseling and training of this nature is difficult for most people. In many instances, it is considered as another unpleasant chore to be over and done with, for it is a difficult task to sit down with a fellow human and frankly but tactfully criticize his performance. That is why so often the line managers are happy to have the staff function handle it.

The problem lies in the initial counseling sessions. Normally, the initial evaluations are always difficult for both the superior and the subordinate. The counseling session runs from fair to poor because of inexperience. This should be taken into consideration and the manager informed that this is expected. He is dealing with a technique that, although it is not new, the approach is

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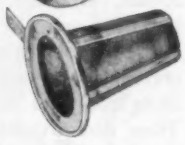

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Specialists to the Petro-Chemical Engineering Field . . . based on scope, quality and service. Equipment available from stock, or made to your exact requirements.

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What do you want in WELDING FITTINGS?

For any welded piping job you want fittings that fit — no disgusting last-minute complications.

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You want a source for special as well as regular fittings. You want to avoid unnecessary welds, makeshift expedients, clumsy combinations.

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And — you want to know your business is appreciated.

The best answer to your welding-fittings wants, of course, is in your nearby J&L Supply store.

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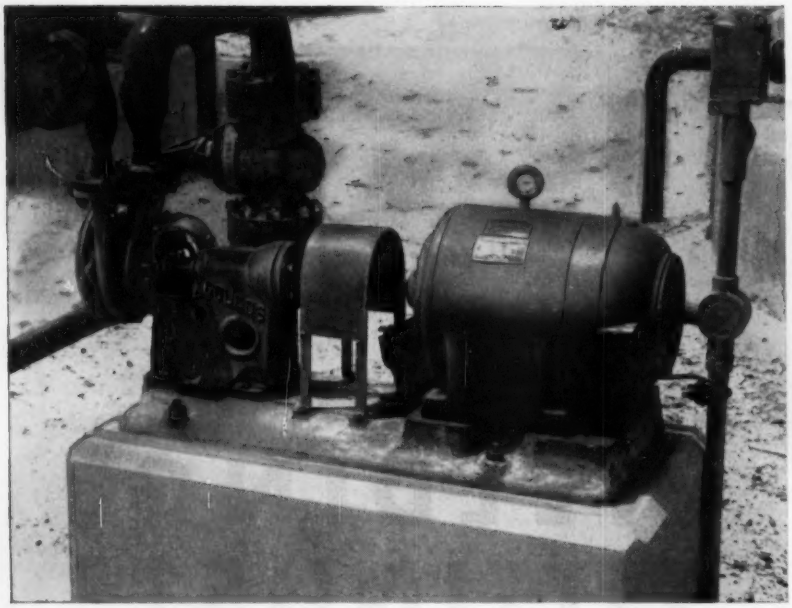


THIS OLD-TIMER *laughs* AT SALT WATER DAMAGE

It's a Goulds chemical pump

Its fluid end was built to handle salt water . . . has been handling that corrosive stuff for a long time.

That fine old pump (a Fig. 3705) has been redesigned. Now, as Fig. 3715, it's even better.

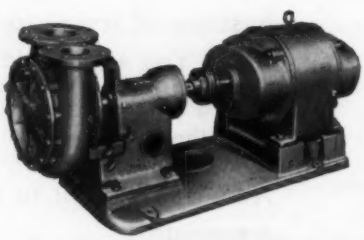
Designed to resist corrosion

This pump is available in a variety of materials: Type 316 and Gould-A-Loy 20 stainless steel, all aluminum-bronze, all iron or bronze fitted. Each of these materials offers specific resistance to corrosion, abrasion, pitting, and other pump hazards. All you have to do is match the metal to your pumping problem. (For example, a fluid end in aluminum-bronze is best for salt water duty.)

All-around economy

Properly specified, these pumps give long service under severe conditions. Because many parts are interchangeable, you can standardize on Fig. 3715 for a variety of liquids, and need only a low spare parts inventory.

For complete information on these remarkably durable pumps, ask for Bulletin 725.4.



Goulds Fig. 3715—Nine sizes: capacities to 720 GPM, with heads up to 200 ft.

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As Management Sees It . . .

different and requires the utmost tact and diplomacy in order to obtain maximum effectiveness. After a period of time, not only does the manager's ability improve, so does his confidence. From that point on productive counseling will occur.

One of the questions that frequently arises, is what is expected of the counselor? Does he have to be a combination psychologist, psychiatrist, humanitarian and expert organizer? How can the ability to appraise be increased? The answer to some of these questions lies in the following:

(a) A sincere and unselfish interest in helping his subordinate improve.

(b) A thorough and realistic knowledge of the job his subordinate holds and the job to which he can expect to move. The more precise the delegation of responsibility and the more precise for accountability, the easier it is to appraise.

(c) An understanding, in a personal sense, of the individual with whom he is working. What kind of suggestions does the individual accept readily? What are the areas in which he finds it difficult to accept criticism? How does he react to the appraiser's personality? Are his future goals realistic?

(d) Understanding of and confidence in the entire process. An awareness of how his efforts will affect the future of his department and the company. The more completely appraisers at all levels understand the purpose and importance of the entire program, the more successful it will be.

Experience with the plan is necessary before real confidence can be expected. An appraiser who has invested time and energy in appraising and in using appraisal information will more likely invest in them again if he sees direct results from the entire process. The most effective kind of evidence is in some marked improvement in the performance of a subordinate.

To achieve good results there are several logical and necessary rules for a good coach to follow.

1. He operates from the sidelines. He doesn't do all the work himself. He delegates appropriate responsibility. He can't see errors and correct them effectively while he himself is involved too heavily in the work.

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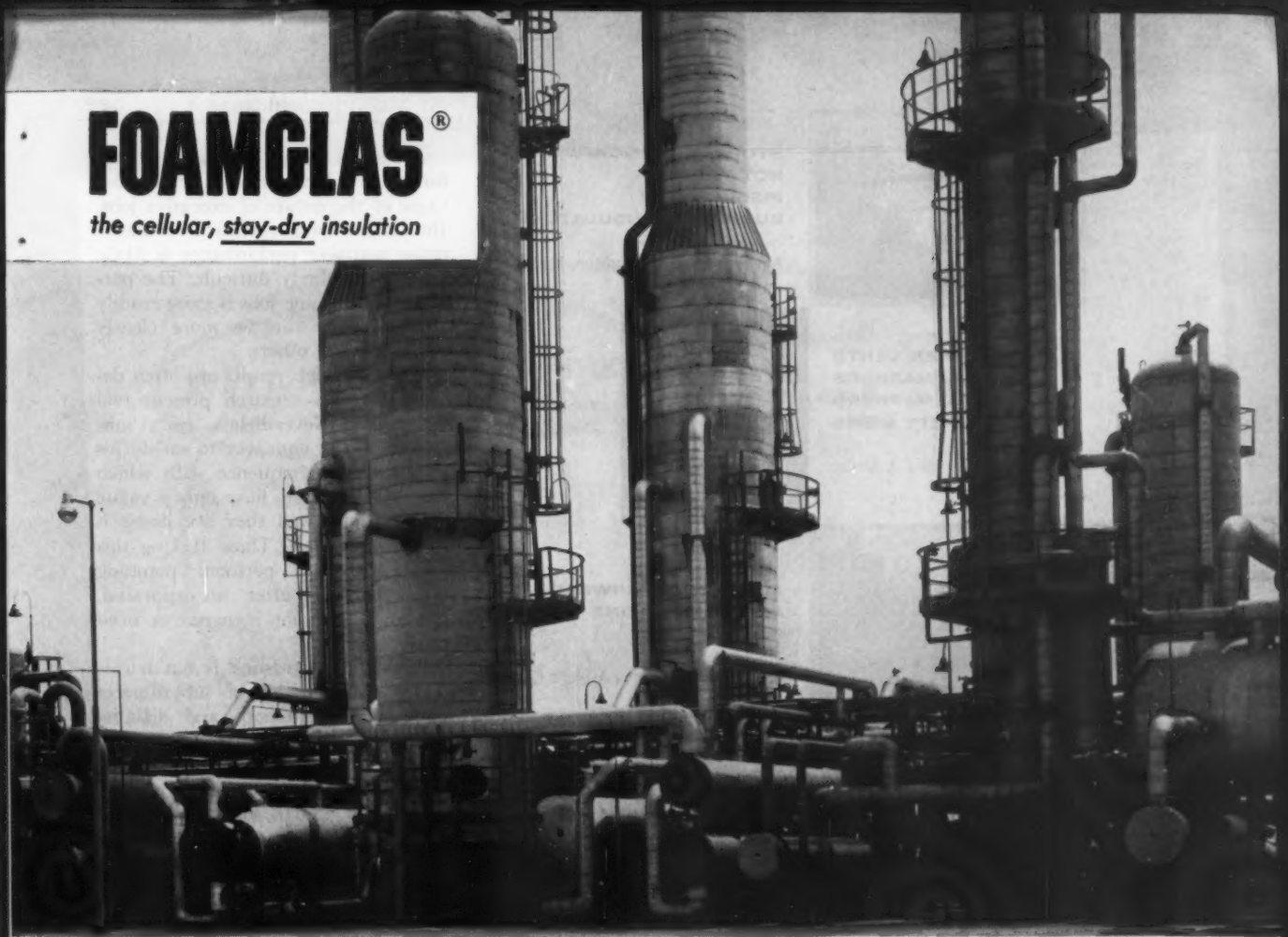
FOAMGLAS®

the cellular, stay-dry insulation



Photograph shows FOAMGLAS insulated low temperature piping and equipment at National Petro-Chemical's hydrocarbon extraction unit, Tuscola, Illinois. Four years' performance has proved FOAMGLAS provides constant insulating value... important to continuous, accurate temperature control on this outdoor equipment. Costly insulation replacement is eliminated. The net result is lower operating costs.

At National Petro-Chemicals Corporation . . .

cellular glass handles tough outdoor insulating job without deterioration

"FOAMGLAS insulation on low temperature piping and equipment proved a good investment at our Tuscola, Illinois, hydrocarbon extraction unit," state engineers for National Petro-Chemicals Corporation. "Back in 1953, we picked this all-glass insulation to insure dependable, economical operation of a reabsorber, two light oil absorbers, three flash drums and all interconnected piping. Operating temperatures range from +29° to −30° F. and the equipment is exposed to the weather."

Such conditions pose a real threat to insulation. Moisture condensation resulting from the exposed location and freezing operating temperatures could ruin a fibrous or porous insulation. But, as National Petro-Chemicals concludes: "Nearly four years of trouble-free performance has proved the dependability of FOAMGLAS. It's handled this tough insulating job without deterioration."

Inorganic FOAMGLAS is composed of millions of non-connected, sealed glass cells . . . each a permanently dry insulating unit. Its insulation value can't vary, no matter how much moisture it's exposed to. Even acid can't harm it!

Whether *you* insulate piping, equipment or plant buildings, consider the valuable combination of benefits which FOAMGLAS alone can give you. It *stays dry!* It's incombustible and acid-proof... dimensionally stable, rigid and unusually strong. Prove it to yourself! Send today for a free FOAMGLAS sample and directions for six simple tests you can easily perform on it. Write . . .

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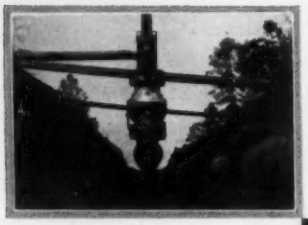
PITTSBURGH PC CORNING ® **Also manufacturers of PC Glass Blocks**

Its light weight, strength and rigidity plus the ease with which it can be cut or shaped with ordinary tools speeded the application of FOAMGLAS, helped keep installation costs down. Insulation was applied by J. F. Pritchard Company of Kansas City, Mo., who also designed and installed the process units.



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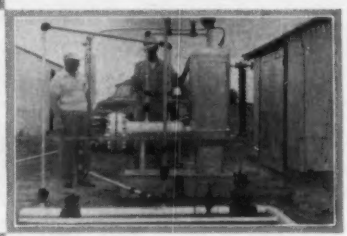

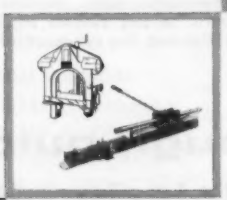

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As Management Sees It . . .

2. He has certain standards of performance which he can define. Because of the nature of executive jobs, the search for a yardstick for measuring manager performance is likely to be exceedingly difficult. The performance of some jobs is more readily observable or can be more clearly analyzed than others.

Jobs in which results are often delayed such as research present real difficulties. Nevertheless, each subordinate must endeavor to satisfy his superior. The frequence with which managers say they have only a vague idea of how well they are doing is surprisingly high. Those lacking this knowledge find personal planning difficult, even after an appraisal, and may still not recognize a need to develop.

Actually a yardstick is not necessary if a superior lets his subordinates know his satisfactions and dissatisfactions with the latter's performance. In the end, that is the only real yardstick a subordinate can effectively understand, and a superior can use.

3. He recognizes individual differences. He understands that everyone doesn't have the same abilities and aptitudes. He doesn't attempt to make all members of the team act alike or act like him.

4. He knows that the school of hard knocks is fundamentally a good one, that men learn best by doing and then by living with the results.

5. He is ineffective unless he is respected. His group must believe in his ability and understand that his ability has produced good results for him and the organization.

6. He doesn't look for miracles but is satisfied with average progress, with success on one phase at a time, with gradual but permanent progress.

A fault that arises in many programs which must be watched with caution is the overemphasis put on promotion. It is deceptively easy for executives, as well as candidates for executive posts to think of an executive development program chiefly as a conveyor belt to bigger jobs.

Management development, if it is to do a company or individual its fullest good, is much more comprehensive. It enhances the capabilities of all men exposed to it whether they move up fast or not. ##

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REGISTERED PROFESSIONAL CHEMICAL ENGINEERS

W. H. & L. D. BETZ

Chemical Engineers

CONSULTANTS ON ALL WATER PROBLEMS

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GILLINGHAM AND WORTH STREETS
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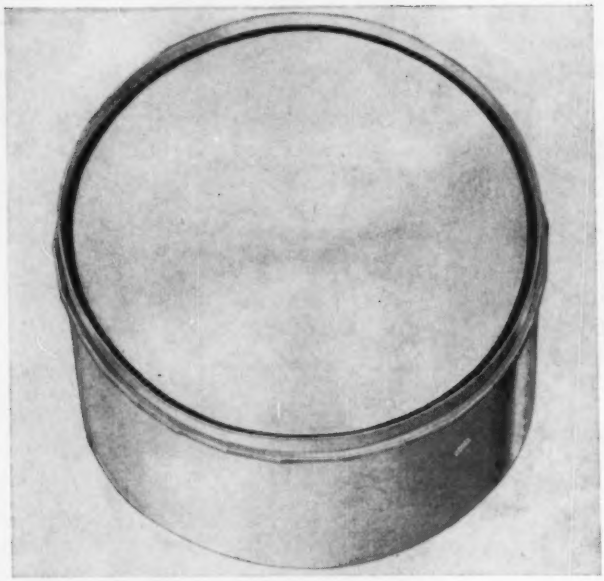


FIGURE 1—This modern roof has underseal hangers and very few connections above the seal—the type most often ignited by lightning.

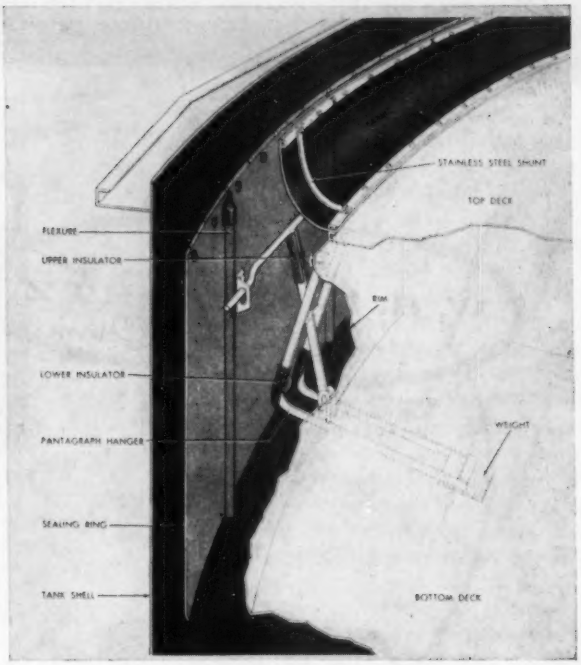


FIGURE 2—Shown above is example of older roofs with hanger contacts above seal and many points of bleed off to the atmosphere.

Safety and Fire Protection—Part 4

Controlling Floating Roof Tank Fires

Caused chiefly by lightning, this type of fire is easy to prevent—and to extinguish.

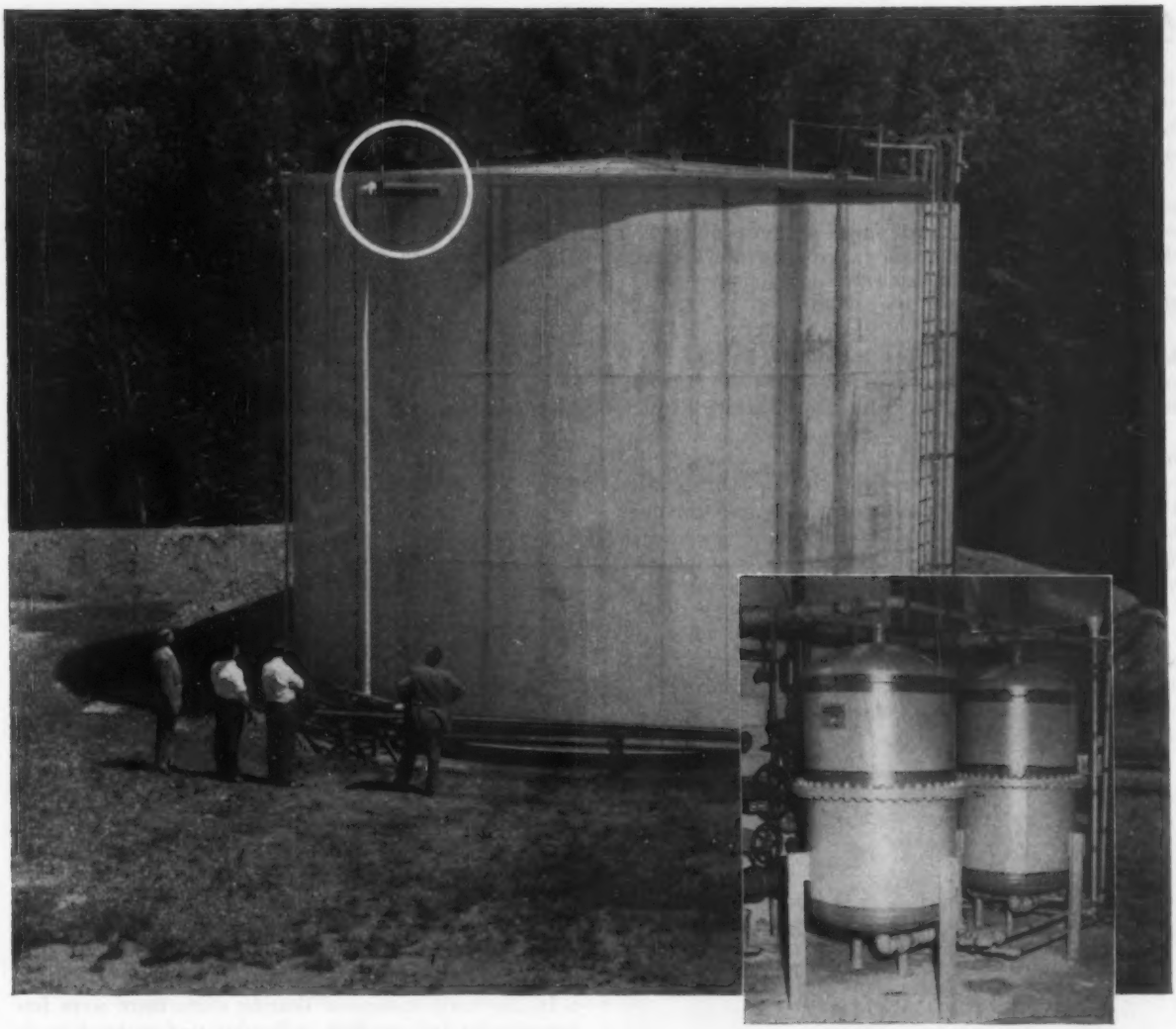
J. L. Risinger
Maplewood, N. J.

FLOATING ROOF TANKS are designed to eliminate open oil surfaces from which vapors escape. Since open surfaces are eliminated in most instances, the probability of fire from static electricity charge is prevented as long as the roof is floating.

A few rim fires have occurred in these tanks when seals were in poor repair. There has been one claim of ignition from iron sulfide accumulation above the roof from storage of high sulphur content crude oil. This was claimed to have occurred when the roof was down in the tank for a considerable length of time.

No fires have been reported from static charge accumulation on the surface of the oil. However, it is to be kept in mind that this is highly possible when the roof is not afloat and when pumping in or agitating an oil in its vapor pressure range of temperature so as to produce an explosive vapor air mixture. Illustrative of this is gasoline below 10 F., aviation gasoline below 30 F., J.P.-4 from 10 to 80 degrees, and kerosine between 110 and 210 F. It can be seen that the one most often within the vapor pressure explosive mixture range is J.P.-4.

How to Prevent J.P.-4 Fires. To prevent fires in floating roof tanks in which J.P.-4 is stored, special precautions are required to prevent rapid charge accumulation during initial pumping until the roof has been floated. This filling should be done with no water bottom, and by gravity flow or very slow pumping in rate. Once the roof is afloat with these products, which at normal tem-



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peratures are blanketed with a vapor-air mixture within the explosive range, the tank should not be pumped to below the floating depth of the roof except for cleaning or repairs.

Crude oil has not been known to accumulate a static charge on its surface faster than it can normally bleed off to the shell of the tank. Therefore, these precautions do not appear to be necessary even though the specific crude oil should have a vapor pressure conducive to explosive vapor-air mixtures near its surface.

Lightning Ignition of Floating Roof Tanks. For a period of years after the advent of the floating roof no fires were reported in these tanks from lightning ignition.

In recent years quite a few floating roof rim fires have been ignited by lightning. It might be assumed that the reason for this is the increased number of floating roofs. However, the proportionate number of lightning ignited fires is several times greater in recent years than formerly. To arrive at the real reason, the phenomena of lightning must be applied to the design and construction of the early floating roofs and those of recent years.

A few findings taken chiefly from the National Bureau of Standards Handbook H 40 will establish sufficient lightning phenomena on which to base corrective measures for the prevention of lightning ignition of floating roof rim fires.

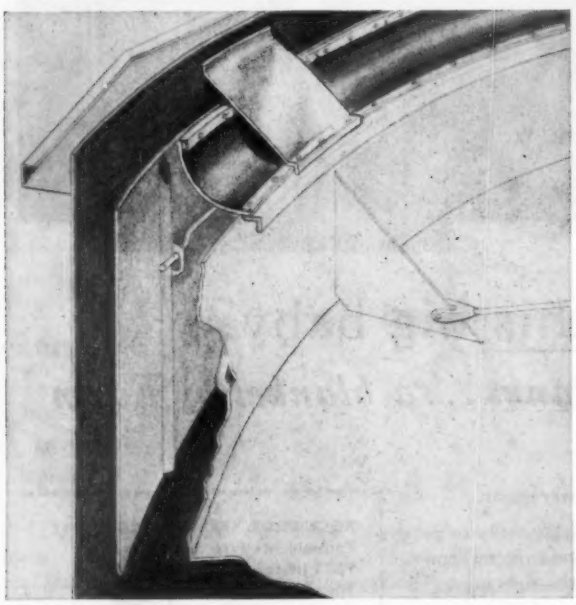

FIGURE 3—The drawing above illustrates a roof with wide bands extending from roof to shell. Tests are being run on effectiveness of a sufficient number of wide strips of steel welded to the edge of the roof bridging the seal and pressing against the shell of the tank.

Hazards of Streak Lightning. The secondary or induced effects from "streak" or chain lightning are responsible for a large majority of fires that occur in oil tanks, reservoirs and oil tank farms. These occur as a result of sparks produced in or about the tanks where burning vapor air mixtures exist.

Traveling on a conductor, streak lightning has a charge of such magnitude and force as to lead to the conclusion that it and its induced charges do not necessarily follow the path of least resistance to ground or other objects, but the nearest path to the greatest attraction. It appears that neither streak lightning nor a heavy induced charge from its flashes will turn sudden corners or go back in the direction from which it came, even if a considerable jump is required to another conductor leading in the same direction of its travel.

From this data it is possible to calculate the potentials which may be attained, and the values of change in potential gradient due to lightning flashes. In the case of a tank roof floating on the non-conductor oil and in the immediate vicinity of the flash where side flashes have been observed to jump several feet from small insulated metallic surfaces, the values of change in potential gradient would be difficult to calculate. Likewise, it would be difficult to calculate the number and capacity of contacts from the roof to the shell that would be necessary to prevent a side flash jump.

Even in the case of reservoirs and oil tanks inherently grounded, induced effects of lightning are accredited with ignition of a large majority of fires as a result of sparks produced in or about the tanks where escaping gases can be ignited.

Value of Hanging Roofs and Projections. In Figure 1, the seal of the floating roof has been added. The ladder and hangers have been placed. These would take care of lightning induced charges only on the roof. However, charges of considerable magnitude would no doubt jump between roof and shell under the seal, or meet with sufficient resistance along the hanger to produce a high enough temperature to ignite vapors in the explosive range. This drawing brings the completely insulated metal body—the roof—to an approach of the modern floating roof in which a majority of lightning ignited rim fires have occurred.

In the early history of floating roofs there were few lightning ignited rim fires in floating roof tanks. A study of the first floating roofs reveal that there were more hangers, and these hangers were above the seal. (See Figure 2). Most of the roofs had a network of pipes and projections from the roof, and many had wire connections extending from these pipes to hangers. Many of the modern roofs also have these pipes and some the wire connections.

Some of the old roofs had such a network of wires above the roof as to resemble the Farady cage. Comparing this type of roof with Figure 1, it can be concluded that lightning ignited rim fires in floating roof tanks have increased with the reduction in the number and capacitance of direct contacts between the roof and the shell of the tank above the seal. The same is true with projections from the roof which might bleed off the induced charge to the atmosphere.

Perhaps floating roof rim fires have occurred from direct hits which ignited leaking vapors when roofs were near the tap. But evidence strongly indicates that all, or all but a few, of these fires have resulted from induced charges on roofs not sufficiently in direct channel contact above the seals of the tanks.

In a study of these ignitions observers have noted the

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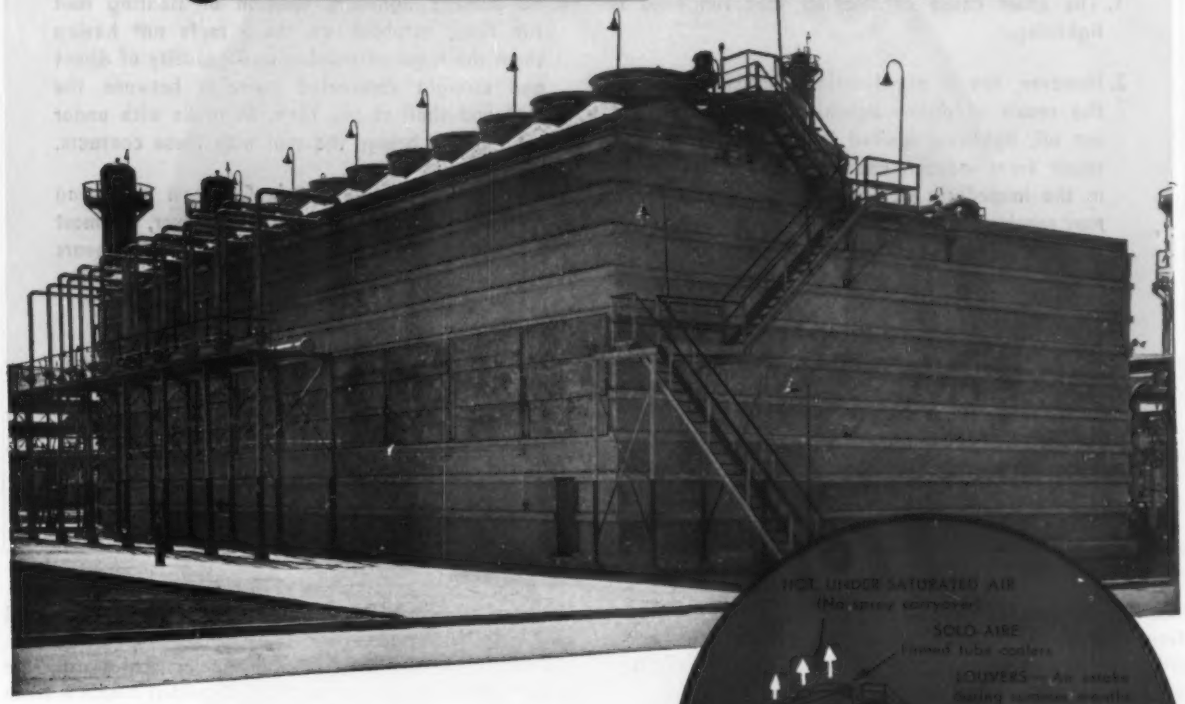

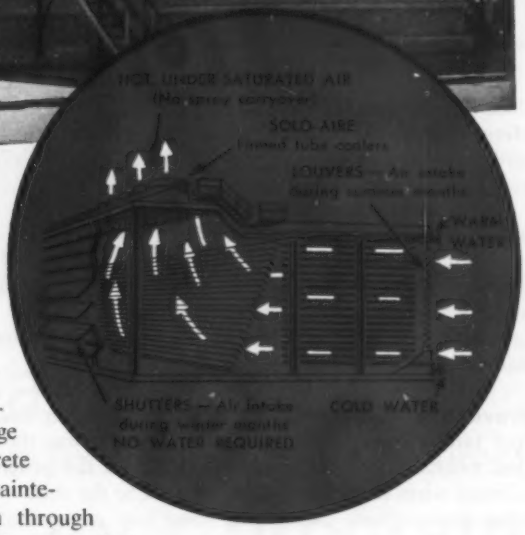

Where quantity or quality of water is low, and ambient air temperatures too high to permit direct cooling with air, process plant designers find the modern solution in Combin-aire. In addition to large savings through minimizing water consumption and eliminating water treatment, Combin-aires incorporate many other advantages.

The Combin-aire pictured above, installed in a large gas processing plant in northern Mexico, is of concrete construction, eliminating fire hazard and minimizing maintenance. As shown in the cut-away drawing, air is drawn through cooled water by fans located on top of the structure. The air, precooled and washed free of solids by the water, flows across the finned tube coolers, and leaves the top of the Combin-aire at elevated temperature under-saturated with water vapor. Mist carryover, condensation from effluent air, and air recirculation are thus eliminated. Combin-aires are installed adjacent to process equipment, minimizing piping and concentrating operating area.

In winter, air flows directly to the Solo-aire finned coolers, water circulation being unnecessary. Where water is required for shell and tube units or atmospheric sections, such water may also be cooled in the Combin-aire unit, eliminating the conventional cooling tower.

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FACTS YOU SHOULD KNOW ABOUT FLOATING ROOF TANK FIRES

1. The chief cause of floating roof rim fires is lightning.
2. However, few if any floating roof rim fires are the result of direct lightning strikes. Most, if not all, lightning ignited floating roof rim fires result from induced charges on the roof, which in the immediate vicinity of the thunder storm, may reach a potential gradient immediately after a flash comparable to the appearance of a direct hit.
3. Lightning ignited rim fires in floating roof tanks have increased with changes in design. The changes have reduced the number and capacitance of direct contacts between the roof and shell of the tank above the roofs or contained seal, and projections and cross wires above the roof contacting the shell of the tank.
4. To prevent lightning ignition of floating roof rim fires, establish on those roofs not having them the required number and capacity of direct and straight channeled contacts between the roof and shell of the tank. In tanks with under seal, vapors bridge the seal with these contacts.
5. The providing of a Farady Cage on a floating roof might reduce the ignition. However, the most feasible method of preventing ignitions appears to be the establishment of contacts between the roof and shell above the gas tight seal.
6. Floating roof rim fires can be effectively fought and easily extinguished with portable equipment. The ease with which these fires can be extinguished is dependent upon the attack of the fire before large sections, or all of the seal has burned out.

flash on the tanks, sometimes even hearing the clap. None have reported seeing the streak leave the cloud and strike the tank. The reaction at ignition of these floating roof rim fires also support the induced charge conclusions.

In one case where six crude oil tanks of a group of 12 were ignited simultaneously when a low hanging electrically charged cloud passed over them, the seal of the floating roof of one of the tanks blew out at six places around the tank. These roofs were of the under seal hanger type. No doubt flame occurred simultaneously under the seal at these six points.

Preventive Measures. When the rim fires in floating roof tanks began to increase in number, it was thought that extensive grounding of the tank and the providing of bond wires from the roof of the tank to the shell would solve the problem. Neither of these had any noticeable effect on the number of ignitions.

In fact, in a heavy lightning area a floating roof gasoline tank was ignited at the rim by lightning. It was a double-deck, pantagraph, under seal hanger type roof and the explosion under the seal blew out about a third of it and actually bulged the shell of the tank, and bent the roof at the point of explosion. The tank was repaired, heavily grounded with auxiliary ground wires and pipe driven to constantly wet soil. The recommended bonding cables from roof to shell were installed and the tank put back into service.

One month later the tank was again ignited during an electrical storm in the same manner as before. The six crude oil tanks that were ignited simultaneously were grounded and equipped with bonding cables from roof to shell.

After these fires, grounds and bonds were tested and there was no greater resistance between the roof and shell when they were disconnected than with them connected. However, they were left connected, tanks repaired and put back into service.

Twenty-six days later during an electrical storm, one of the tanks was ignited again. The added contacts from roof to shell may have reduced chances for ignition as a result of induced charges, especially light ones. However, they did not do the total job of preventing them.

Experience indicates that even where the roof hangers are above the seal, they—together with the ladder—are not enough to provide a sufficient area of connection at the right places to prevent all fires. Neither will the auxiliary cable and wire bonding provide the contact required. Also, grounding of the tank itself will not greatly influence the number of lightning ignitions of these tanks.

No doubt if the seal itself was of effective conductive material, the lightning ignitions would be reduced provided the seal was kept in good repair. However, no material has been found out of which to build seals that have as little resistance as metals. Therefore, there might be sufficient resistance in the seal to cause it to be ripped open.

Some companies build floating roofs in which a rim of steel presses directly against the shell of the tank as a shoe or hanger under which the seal itself extends below liquid level. This is a new type and there has not been sufficient experience to substantiate that they will not become lightning ignited. However, none have occurred in these tanks to date, and their construction would indicate that such ignitions should be very rare, if ever.

Extensive tests are being made by one manufacturer to determine the best methods to provide necessary contacts between the roof and shell of tanks that do not have contacts above the seal. These tests include a system of a sufficient number of wide strips of stainless steel attached to the roof, bridging the seal and pressing against

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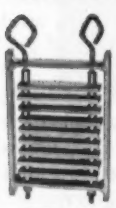

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the shell above it. If a sufficient number of these are used it is believed they will serve the purpose (See Figure 3).

Steel strips are not required on roofs where there are multiple contacts between the roof and shell of the tank above a tight seal, or if a sufficient number and capacity of contacts are under the seal which rests directly on the surface of the tank. It is to be kept in mind, however, that oil is insulating and current will not travel as readily along the surface of a metal submerged in oil as in the atmosphere.

In figuring the justification for the extra construction and design required as precautions against ignitions of floating roof rim fires on the graded risk basis, consideration should be given to:

- Standard design of the roof.
- The height of structures in the vicinity of the tank.
- The frequency of thunderstorms in the region.

Extinguishment of Floating Roof Fires. Floating roof rim fires can be easily extinguished by use of foam hose nozzles from the top platform, driving the fire away from beneath the platform with the foam, fog, or dry chemical and then proceeding around the tank.

In heavy lightning areas some companies place a line with a Y-connection, with valves on each angle of the Y, so that foam, started from ground level, will drop from the bottom line of the Y onto the seal below the platform and extinguish the fire at that point. Then the fire fighters can mount the steps and platform, connect a hose to the top line of the Y, open the valve on the line, close the valve on the bottom line, and then extinguish the remainder of the rim fire from the roof of the tank by use of the foam line and nozzle.

Rim fires have been successfully fought with dry chemical extinguishers, in sizes in accordance with the size of the fire—also by sliding a light foam tower (applicator) around the tank to cover the seal where burning. If this method is to be used, attention should be given in advance to see that the croak of the tower is wide enough to span the wind girder.

Other companies are building a walkway around the tank below the tap. From these walkways the rim fires can be easily extinguished by use of portable equipment. Some have allowed the fires to continue to burn until the tank was completely lost because of the fear of getting on the roof to extinguish the fire.

If the fire can be extinguished and kept extinguished around the ladder, especially on pontoon and double deck roofs, the fire can be safely fought from the roof unless the complete seal is on fire and the roof is so low that flames and smoke are too severe on the fire fighter.

If the fire is to be extinguished with dry chemical, and the rim is on fire around the entire roof, two men should attack the fire simultaneously in team work, starting together, then going in opposite directions and meeting at the opposite side of the tank.

It is best to plan the fighting of these fires in advance of their occurrence, and better still to prevent the fires so that plans will not have to be put into execution.

Part 5 will appear in the May issue of PETROLEUM REFINER

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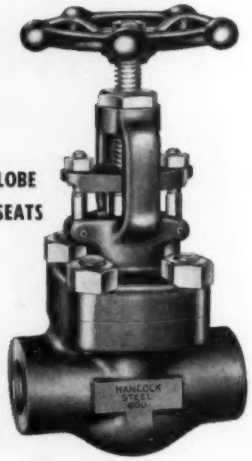
NEW 600# STEEL

NEW

TYPE 5500 — 600# GLOBE
INTEGRAL HARD-FACED SEATS
"500 Brinell"
Stainless Steel Discs.



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These 600# bolted bonnet forged steel valves really make sense to every man who knows the economy of quality valves. Designed into them are plus values that substantially reduce profit-draining production shut-downs, maintenance problems and inventory costs. Built as companions to the widely-used Type 950 Hancock 800# Steel Gate Valves, they offer:

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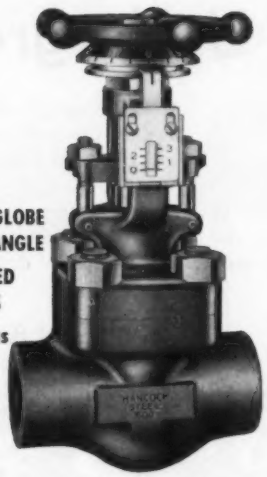

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TYPE 5505 — 600# ANGLE
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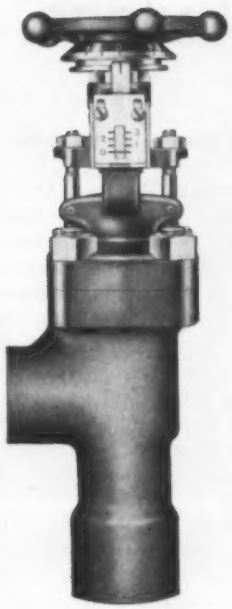

An orifice type valve, with shut-off and index in a single unit that permits the use of a smaller valve with a large capacity. Designed to withstand the terrific wrecking power of continuous blow-down. Also for use on feed-water, by-pass relief, in turbine washing processes, and where erosion is extremely severe. **Size:** 1". **Standard Materials:** Forged carbon steel. **Connections:** Screwed and Socket Weld Ends. For all pressures up to 600 psi at 910°F. O.W.G. — 2000 psi at 100°F. A.S.M.E. maximum boiler pressure 970 psi.

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What's Happening . . .

. . . in the Industry

Ethylene, Propylene Go Underground

Esso's salt dome storage facilities slated to hold more than one million barrels.

THE ESSO STANDARD OIL CO. SOON will have in readiness underground facilities for storage of butane, propane, ethylene and propylene produced at the company's Baton Rouge refinery. H. J. Voorhies, Esso vice-president and general manager of the Baton Rouge refinery, announced that drilling operations have been completed on three of five projected cavities in a salt dome formation near Sorrento, 35 miles south of Baton Rouge.

Voorhies said that Esso is installing the new storage facilities for three purposes: first, to meet the demands of the increasing number of chemical companies which use ethylene and propylene as basic raw materials; second, to provide storage for butane and propane during seasons of low demand and, third, to provide storage for butane and propylene to be used in refinery operations.

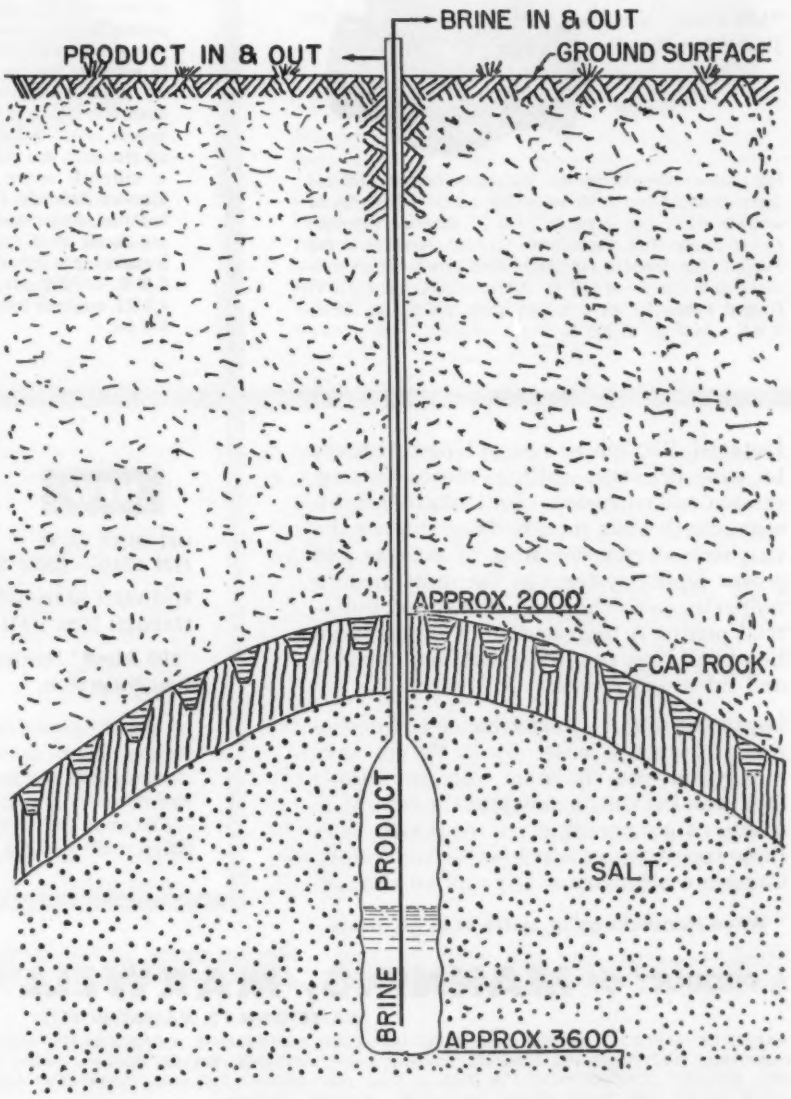
Total capacity of the underground cavities, when completed, will be more than one million barrels. The storage project will cost approximately $1 million. This amount includes cost of clearing the site, located in a dense second-growth cypress forest.

The products will be transported by pipe line between the refinery and the salt dome storage.

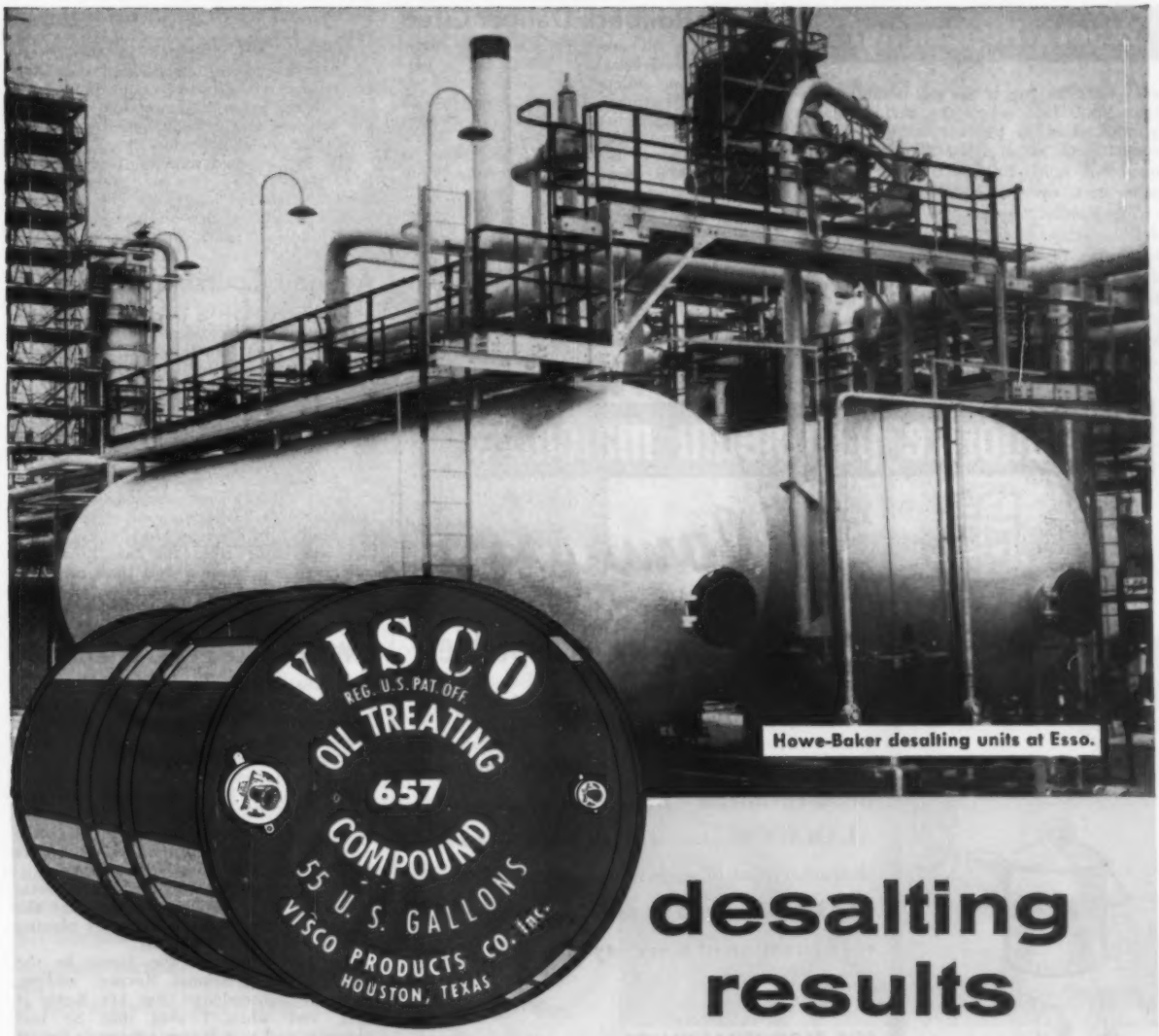
Esso leased a 100-acre tract in the Sorrento salt dome area in which to install the new storage facilities. In addition to the five storage cavities and attendant apparatus, the facilities include a 1.1 million barrel capacity brine pit.

When the product is removed from the top of a cavity, brine from the pit is simultaneously injected into the bottom of the cavity. Thus the cavity is kept full of liquid at all times. Because the product is lighter than the brine solution, the product content of the cavity is held constantly at the top of the storage space. Brine is used in the operation because fresh water would produce a leaching action which would enlarge the size of the cavity.

The cavities are formed by leaching, or dissolving, the salt at the bottom of wells drilled into the solid



Sketch of one Esso's underground storage cavities in the salt dome near Sorrento, La.



Howe-Baker desalting units at Esso.

desalting results

. . . a foregone conclusion at Esso's Bayway Refinery

The modern equipment shown above is one of the recent additions to the Esso Standard Oil Company Refinery at Linden, New Jersey.

With equipment such as this, plus the familiar blue barrels of Visco, outstanding desalting results are a foregone conclusion.

Visco, in either electrical or salt settling equipment, still provides the consistently efficient — and economical — chemical solution to the problem of greater throughput and lower corrosion costs.

Specific information on your particular desalting needs is readily available through your Visco Representative, or contact Visco direct.

VISCO PRODUCTS COMPANY
INCORPORATED
2600 Nottingham at Kirby — Houston 5, Texas
Telephone: MAdison 3-0433

Visco® CONSISTENTLY EFFICIENT OIL INDUSTRY CHEMICALS

For more data on advertised products, use Readers' Service Cards, last page.

What's Happening. . .

rock salt. The top of the salt dome is more than 2000 feet below the surface of the ground. Two of the cavities will have a capacity of about 150,000 barrels each, one will hold 200,000 barrels and the other two cavities 300,000 barrels.

The smaller two of the roughly cylindrical cavities measure about 850 feet from top to bottom and are 35 feet in diameter. The other cavities are proportionately larger. The distance from ground surface to cavity bottom is approximately 3,600 feet. (See drawing.)

Price Rollback Danger Cited

If large oil companies yield to some Congressional cries for "rollbacks" in gasoline prices, independent refiners will be put out of business, President Reid Brazell of Leonard Refineries told the Senate (O'Mahoney) hearings.

In testifying in behalf of the Western Petroleum Refiners Association and the National Petroleum Association, Brazell maintained, "Independent refiners would face ruin if product prices were rolled back without a similar rollback in the price of crude oil."

Economics require that refiners pass on increased prices to the consumer. Not only must crude oil price hikes be included in costs, he said, but also wage increases and higher costs for chemicals and steel products.

Counsel Don McHugh of the Senate antitrust subcommittee asked if independent producing business was not more profitable after price increases than the refining business, and Brazell replied that many producers make little money.

"In fact, I have one oil well I'll give you," Brazell said. One well owned by his company costs more to operate than production could balance he explained.

McHugh declined the offer.

Asphalt Course at California

The University of California's institute of transportation and traffic engineering will offer the second annual graduate study program in asphalt paving technology, supported by a grant from The Asphalt Institute.

The eight weeks' course, open to qualified college engineering instructors, will begin June 17 at the College of Engineering in Berkeley. Twnty grants-in-aid of $900 each have been established by the University of California which will furnish study and residence facilities. Instructors will come from the faculty of the college of engineering and staff members of the institute of transportation and traffic engineering.

"My Error" Says O'Mahoney

Senator O'Mahoney apologized on the Senate floor to Humble Oil & Refining Co. president Hines Baker for previous erroneous "interpretation of the relationship" between Humble and Standard Oil Co. (New Jersey).

The Senator had previously said that Baker testified before the joint Senate subcommittees, investigating crude oil price increases, that "Humble takes its orders from Standard of New Jersey."

Baker refuted O'Mahoney's interpretation of his testimony and asked that the Senator acknowledge the error by placing Baker's letter in the records.

O'Mahoney placed the letter in the March 1 Congressional Record, adding, "I gladly acknowledge that Mr. Baker is right, and when I said that he had acknowledged that Humble takes its orders from Standard of New Jersey, I must confess that I was in error as he says."

Jet Fuel Needs Discussed

The recent meeting of the Mid-Continent section of the Society of Automotive Engineers at Bartlesville, Okla., saw high echelon representatives from the aircraft engine, aviation, and oil industries discuss the requirements of commercial jet fuels.

Principal speakers were: M. G. Beard, assistint vice president of equipment research for American Airlines; M. C. Hardin, chief of Fuels, Lubricants and Combustion division of Allison division of General Motors; and R. C. Alden, chairman of the Research Planning Board for Phillips Petroleum Co.

The speakers reported that:

Commercial jet fuel requirements in 1955 were at the rate of approximately 1050 barrels per day; by 1960 this rate can be expected to rise to 32,000 barrels per day. Avgas consumption on commercial airlines will rise to a peak in 1959 when it will remain constant or start to drop. At this time turbine fuel consumption will rise rapidly. (Beard)

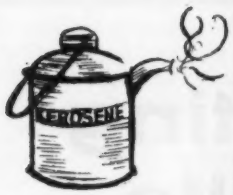
The oil industry can be geared to supply almost any possible future fuel requirement. At a refinery process rate of 10

reodorize petroleum malodors

with Alamask!

Make olfactorily acceptable petroleum products!

Producers of petroleum products and of petro-chemicals – by adding a selected ALAMASK reodorant – can improve odor characteristics of such materials. A specific ALAMASK is available to achieve adequate reodorization of a variety of petroleum products.



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FUEL OILS (regular or premium gasoline blends)
KEROSENE
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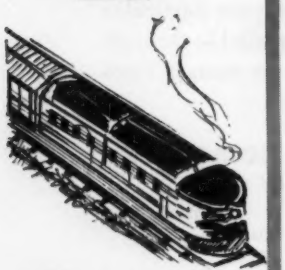
CUTTING OILS and SPECIALTIES
many other petroleum products

Gain olfactory relief with an ALAMASK.

Write, wire or phone for specific information. Our Engineering Section provides complete technical guidance.



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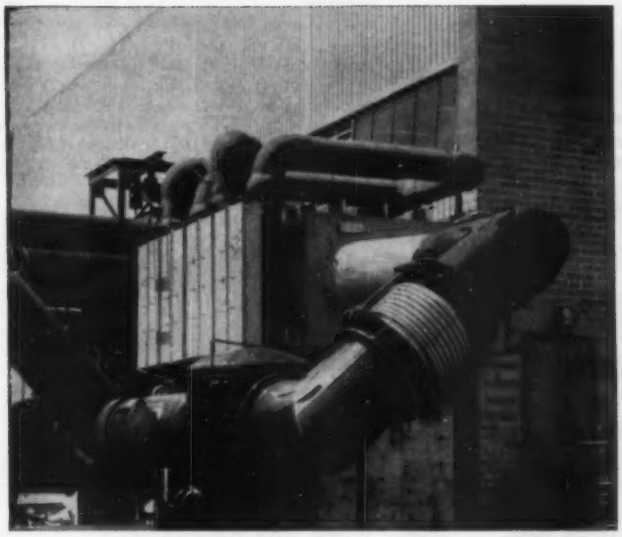


SPECIAL EXPANSION JOINTS

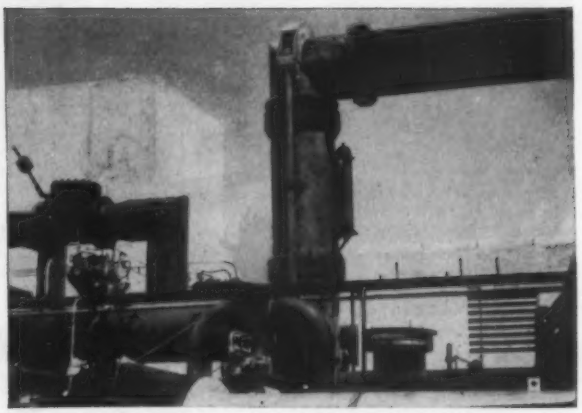
are Second Nature to

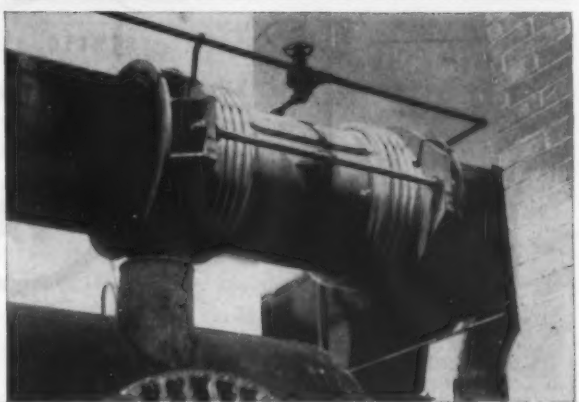
ADSCO

These photographs show installations of special ADSCO Corruflex Expansion Joints at the Fairchild Engine Division, Fairchild Engine & Airplane Corp., Deer Park, Long Island, N. Y. All joints are designed to absorb lateral motion only, except that the long universal joint, right center, also absorbs any axial growth of its own. All joints are equipped with internal sleeves to smooth out the flow of high-temperature air being carried by the piping systems. They are not standard joints; they are specially engineered, specially manufactured.

A few years ago, when ADSCO was pioneering packless joints for special work, a job like this took considerable engineering and manufacturing time... because it was a new field. But since then, ADSCO has acquired so much experience from so many special orders that special jobs like the Fairchild one are truly "second nature".

Special applications of packless joints are developed carefully but not laboriously. Experience enables ADSCO engineers to get the work out easily and with confidence. Consult them next time you have a special piping problem.





REMEMBER!

Use ADSCO Expansion Joints instead of Pipe Bends because of these advantages.

1. LESS HEAT LOSS
2. LESS PRESSURE DROP
3. LESS SPACE
4. LESS COST

AMERICAN DISTRICT STEAM DIVISION
YUBA MANUFACTURING COMPANY
20 MILBURN ST. BUFFALO 12, N. Y.

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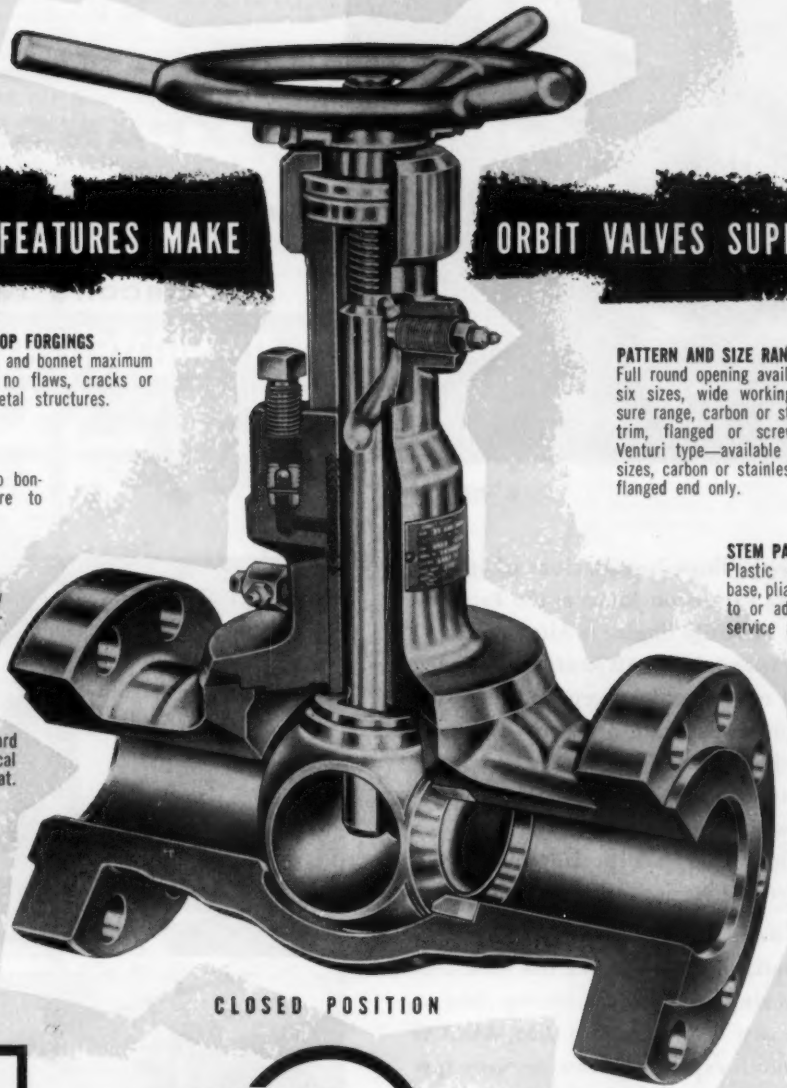
BUILT-IN FEATURES MAKE ORBIT VALVES SUPERIOR



STEEL DROP FORGINGS
Give body and bonnet maximum strength, no flaws, cracks or porous metal structures.

WELDED BONNET
Stronger construction, no bonnet gasket for exposure to corrosion.

FRICTION-FREE SEATING
For easy operation—frequency of opening and closing immaterial.

SEATING
Segment of seating core is hard faced and ground for spherical seating to resilient body seat.

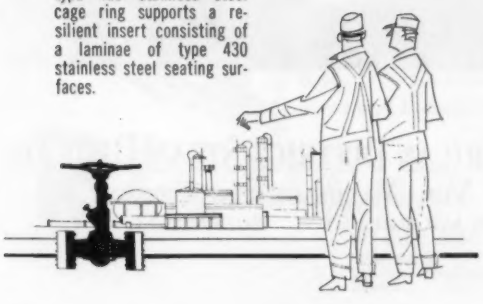
PATTERN AND SIZE RANGE
Full round opening available in six sizes, wide working pressure range, carbon or stainless trim, flanged or screw end. Venturi type—available in five sizes, carbon or stainless trim, flanged end only.

STEM PACKING
Plastic stem packing, teflon base, pliable, adjustable. Can add to or adjust while valve is in service and under pressure.

CLOSED POSITION

RESILIENT BODY SEAT: A type 416 stainless steel cage ring supports a resilient insert consisting of a laminae of type 430 stainless steel seating surfaces.

ORBIT VALVES®



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ORBIT ASA CLASS VALVES FOR AMERICA'S MOST MODERN PLANTS

million bpd of crude, 200,000 bpd of jet fuel can easily be supplied. (Alden)

Engines can be designed and built to operate efficiently on either kerosine type or JP-4 type fuel but a given engine cannot yield optimum efficiency on both fuels. (Hardin)

Kerosine type fuels are more desirable than JP-4 type fuels from the safety standpoint, but availability may dictate JP-4. (Beard)

Because kerosine forms flammable mixtures with air more readily in storage vessels than gasolines, it is often the more dangerous. (Alden)

The trend to the turbine is dictated by lower cost per passenger mile. This lower cost is realized because of the time factor, despite great fuel consumption. (Beard)

WPRA Elects New Officers

Harry J. Kennedy, Houston, vice president of Continental Oil Co., was elected president of the Western Petroleum Refiners Association at the group's 45th annual meeting in San Antonio (see page 306). Kennedy succeeds Reid Brazell, Alma, Mich., president of Leonard Refineries, who has been WPRA president since 1955.

The largest organization of its type in industry, the Western Petroleum Refiners Association is composed of both small and large refiners in the Mid-Continent, Gulf Coast and Rocky Mountains area. Approximately 1500 persons attended the San Antonio meeting.

Vice Presidents

F. L. Martin, Corpus Christi, Texas, Suntide Refining Co., was reelected a vice president of WPRA. New vice presidents elected were W. J. Carthaus, St. Paul, Minn., Great Northern Oil Co.; Rex Blazer, Cleveland, Allied Oil Co.; Walter Famariss, Jr., Hobbs, New Mexico, Famariss Oil & Refining Co.; and J. A. Vickers, Wichita, Kan., The Vickers Petroleum Corp.

New Directors

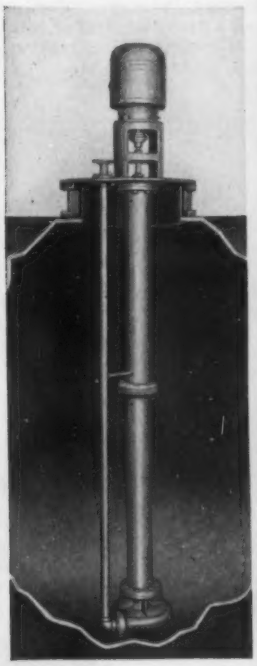
New WPRA directors elected were C. R. Brown, Tulsa, Tidewater Oil Co.; L. W. Robbie, Texas City, Republic Oil Refining Co.; R. G. Sanders, Beaumont, Magnolia Petroleum Co., and E. M. Stone, Denver, Colo., Empire Petroleum Co.

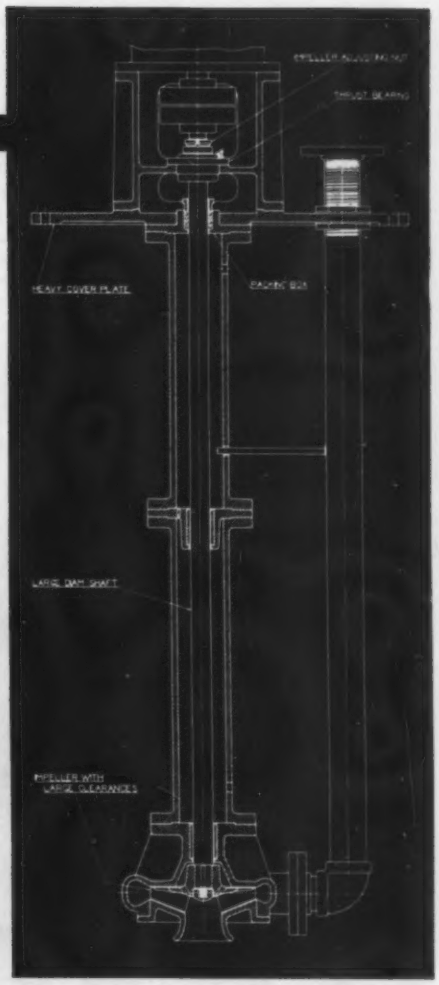
Reelected

Reelected directors were Robert O. Anderson, Roswell, N. M., Malco Asphalt & Refining Co.; Earl Baldridge, Fort Worth, Champlin Oil and Refining Co.; W. T. Cravens, Bartlesville, Okla., Cities Service Oil Co.; Max M. Fisher, Detroit, Aurora Gasoline Co.; T. E. Fitzgerald, Tulsa, D-X Sunray Oil Co.; T. B. Kimball, New York, Sinclair Refining Co.; L. E. Kincannon, Indianapolis, Rock Island Refining Co.; J. P. Langfitt, Chicago, The Pure Oil Co.; L. L. Leabo, Denver, Colo., The Bay Petroleum Corp.; F. C. Love, Oklahoma City, Deep Rock Oil Co.; and R. E. Luton, Findlay, Ohio, The Ohio Oil Co.

Also reelected as directors were E. B. McConnell, Cleveland, The Standard Oil Co. (Ohio); Bruce H. McCully, Kansas City, Mo., Cooperative Refining Assn.;

(Right) Structural details of Lawrence Vertical Chemical Pump.
(Below) Vertical Chemical Pump mounted inside of tank.





VERTICAL CHEMICAL PUMPS

Difficult chemical pumping problems—handling hot concentrated acids, corrosive alkalies, molten salts, molten sulphur, volatile semi-fluids, etc.—have been a LAWRENCE specialty for over 80 years.

To meet the demands of this rigorous service, LAWRENCE Vertical Chemical Pumps are made of metals or alloys carefully chosen to give the best protection against the corrosive and abrasive action of the liquid pumped, as well as structural strength and long wear. Other design features (depending on the circumstances) include liquid seals for high vacuum, the elimination of packing, mounting bearings above the level of the liquid pumped to prevent contact, and many more refinements that contribute vitally to efficient, trouble-free operation.

If you have a particularly difficult chemical pumping problem, write us the pertinent details.

LAWRENCE PUMPS INC.
371 MARKET STREET, LAWRENCE, MASS.

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What's Happening. . .

F. W. McCurry, Wichita, Derby Refining Co.; L. D. Mann, Lake Charles, Cities Service Refining Co.; Henry J. Muller, Detroit, Soconoy Mobil Oil Co.; George J. Peterschmidt, El Dorado, Kan., The El Dorado Refining Co.; A. F. Reed, El Dorado, Lion Oil Co.; Harold R. Snow, New York, American Oil Co.; C. C. Tate, Bartlesville, Phillips Petroleum Co.; J. W. Vaiden, Tulsa, Skelly Oil Co., and Everett F. Wells, Ashland, Ky., Ashland Oil & Refining Co.

Brazell retiring president, will become an ex-officio director of the organization. Other ex-officio directors of WPRA are H. T. Ashton, St. Louis, Mo., Socony Mobil Oil Co.; R. W. McDowell, Tulsa, D-X Sunray Oil Co.; Roland V. Rodman, Oklahoma City, Anderson-Prichard Oil Corp.; L. B. Simmons, Abilene, Texas, Onyx Refining Co.; and R. L. Tollett, Big Spring, Texas, Cosden Petroleum Corp.

Kennedy has been associated with Conoco since 1919. He became general sales manager in 1930 and six years later was elected a vice president. Long active in the Western Petroleum Refiners Association and other industry groups, he recently served a two-year term as marketing vice president of the American Petroleum Institute.

REVAMPS
Require Specialized Engineering Skill
Our wide experience in this field and the flexibility of our organization assure maximum performance with minimum down time.
The illustration shows a portion of the revamp gas recovery system of a large crude unit recently completed for SOHIO.
The
C. W. NOFSINGER
Company
Kansas City, Mo.

May Farm Out Shale Plant

There's a chance that private contractors may be awarded new shale oil research projects at the government-owned Rifle, Colo., plant. Chairman Vinson (D-Ga.) of the House Armed Services Committee has asked the Navy to consult with various agencies on "national defense aspects of shale oil development in preparing a bill authorizing the Navy to award such contracts. To be included, however, would be a clause stipulating that the authorization would be only for research, not for commercial exploitation.

Chairman Vinson said that the Navy has "vital interest" in the research at Rifle. This directly opposes the Interior Department's request that the Bureau of Mines be authorized to resume operation of the plant and devote efforts to mining operations.

Spokesmen for private companies, however, testified that regardless of who assumed supervision, research should be devoted to retorting processes as mining has reached a satisfactory level.

Vice President Fred Hartley of Union Oil Co. of California said his company preferred leasing the plant to a private company rather than contracting with government funds, but either way, the Navy should hold the reins because it is most concerned with the ultimate disposition of shale products (Petroleum Refiner, March, p. 288).

The Rifle plant is presently being maintained with Navy funds but no research is being conducted.

X-Chemical Secret Is Out

Sinclair's secret X-Chemical for motor fuel has been revealed to be tri-n-butyl phosphine. Ever since the announcement of this chemical in Sinclair's gasoline, there have been numerous speculations as to its composition. Now it is out.

Much of the recent play for additives in motor fuels has come from research into the nature of combustion chamber deposits. It was found that high compression engines and high octane fuels work together to aggravate deposit conditions which cause the majority of consumer complaints.

Sinclair believes its compound overcomes the problems of deposits. It claims the composition of deposits produced from fuel containing tri-n-butyl phosphine is chemically different from that produced by other gasolines. In this way the deposits become less harmful in their effect on the performance of automobile engines.

Unions Garb for Big Push

The first agreement on wage increases within the oil industry has been reached, and the results are far below union expectations. By an almost unanimous vote of 1627 to 7, the Independent Petroleum Workers of America approved a four percent settlement offer of Standard Oil Co. (Indiana) made to employes at its Whiting, Ind., refinery. The original offer of the company was three percent.

When the news of the agreement was announced, OCAW chief, O. A. Knight, fearing that the Whiting negotiations may have set a pattern for the rest of the industry, sent word to all other industry bargaining committees. He told them to support union demands, to take strike votes, and to put the pressure on oil companies.

In cooperation with the Central States

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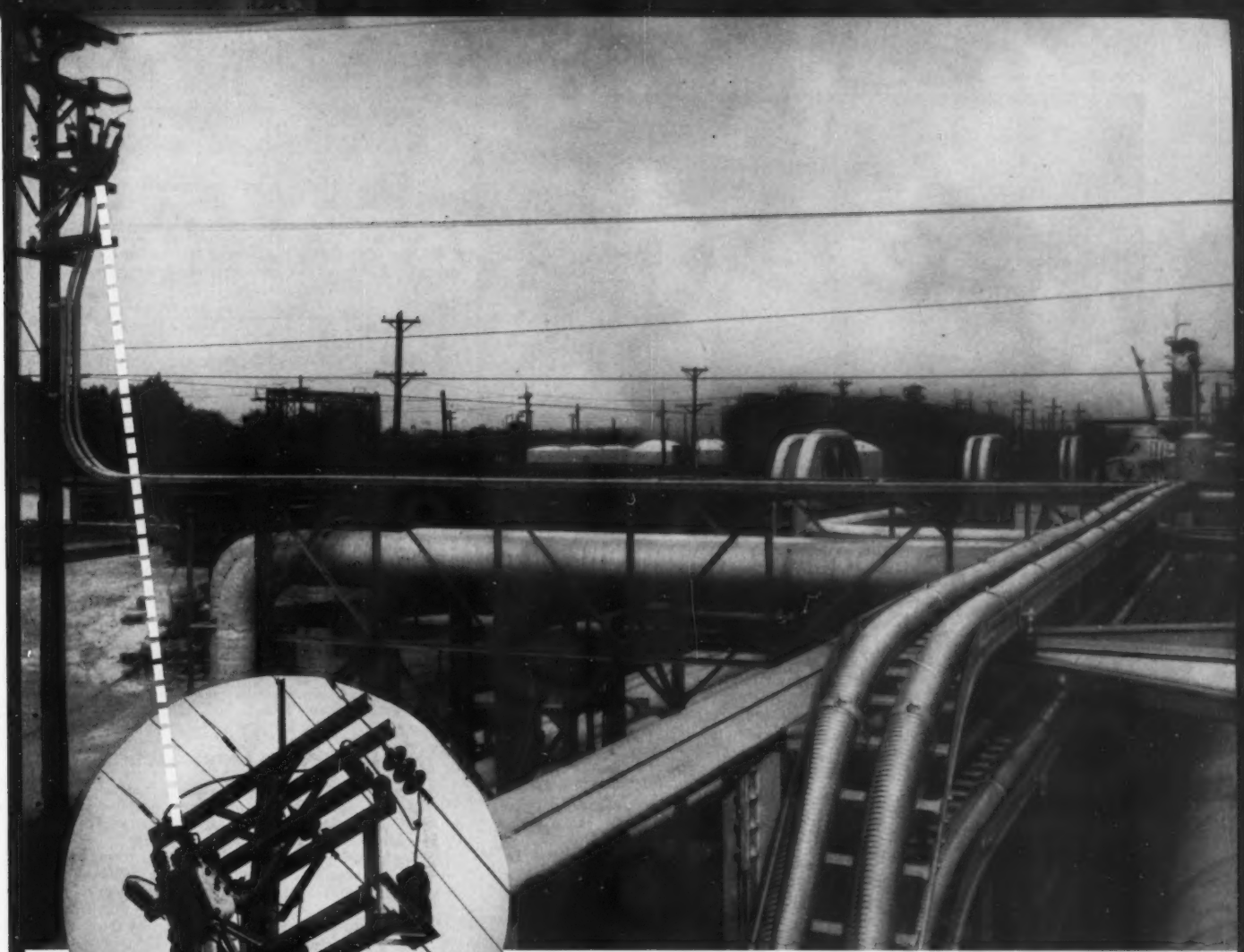

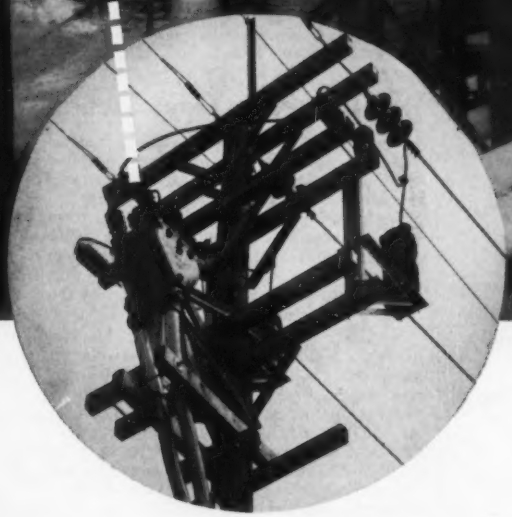

new 15kv Loxarmor* circuits eliminate conduit, allow simple terminations

Stainless steel Loxarmor cable was recently chosen by the Petro-Tex Chemical Corporation, jointly owned by Tennessee Gas Transmission Co. and Food Machinery and Chemical Corp., for main feeder circuits in their Houston, Texas plant.

Heart of this system is Okolite insulation applied by Okonite's strip-insulating method. The advantages inherent in the Loxarmor construction add considerably to the basic advantages of the Okolite insulation.

Advantages of Loxarmor construction:

... stainless steel armor provides the ultimate resistance to corrosive atmospheres prevalent in petrochemical plants.

... reduces installation and maintenance costs because of flexibility and the elimination of rigid conduit. Open type construction permits quick, simple inspection of your electrical system.

... completely salvageable—can be reused at will or can be easily re-routed.

... standard fittings permit relatively simple terminating procedures.

Petro-Tex Chemical Corporation's use of this construction typifies the modern trend to Loxarmor. Where the maximum security of a rigid conduit is not necessary, Loxarmor is a highly acceptable alternate.

Bulletin PR-1090 provides a thorough description of Loxarmor, providing engineering information, splicing and terminating drawings and instructions, and a discussion of the various components. Loxarmor power and control cables are available with any of Okonite's strip-insulated and extruded rubber insulations or with varnished cambric and plastic dielectrics. Write for it today to The Okonite Company, Passaic, N. J.

***Okonite's trade name for interlocked S-shaped armor—available in stainless or galvanized steel, aluminum or bronze. Protective coverings can be applied over the armor for special corrosion and chemical resistance.**

4710

where there's electrical power... there's **OKONITE CABLE**

Repeat Performance in Long Beach

Here's how SWECO after-coolers helped a big-city public utility meet the booming fuel needs of homeowners and industry.

More meals to cook, more homes to heat, new industry to serve. Those were the growing pains that challenged the Long Beach (Calif.) Municipal Gas Department in 1949. How Long Beach solved the problem is told in the efficient performance of four SWECO after-coolers that are currently processing 48,000,000 Std. cu. ft. of natural gas each day in a round-the-clock operation at the city's new Spring Street Compressor Station.

Each SWECO unit exchanges 2,422,000 B.t.u. per hour. Gas from the compressor enters the shell side of each after-cooler at the rate of 24,625 lb. an hour – and at a compression-developed temperature of 255°F. Cooling water in the tube bundle drops this temperature to 75°F.

Heart of system

The compressor station is the heart of a distribution system that depends on a constant, rigid level of pressure to push the gas through a network of lines to consumers. Pressure drops cost money. The plant's four SWECO heat exchangers keep pressure drop well within a tight specification of less than one pound per square inch.

Repeat performance

It was back in 1949 that the Municipal Gas Department ordered its first pair of big, custom-made SWECO after-coolers. But in just six years, even their peak processing performance of 24,000,000 Std. cu. ft. of natural gas every 24 hours proved inadequate. The gas department built a new plant, moved in the original two SWECO-built after-coolers, and went back to SWECO for two more units.

Common denominator

In ordering its second pair of after-coolers, Long Beach joined an impressive list of repeat buyers of SWECO heat exchangers. All have this in common: the need for reliability.

That's why the process industries keep coming back to SWECO . . . for the design and manufacture of *process equipment* . . . for a full line of *vibrating screen separators* . . . for *engineering and construction services.*

Write today for our new brochure on how SWECO can help meet your processing needs – with heat exchangers, feed-water heaters, pressure vessels, distillation columns, steam jet ejectors and surface condensers, pilot plants, packaged heavy-media-separation units. Ask for brochure M-1-333.

SWECO

Southwestern Engineering Company

4800 Santa Fe Ave., Los Angeles 58, Calif.

What's Happening . . .

Petroleum Union which represents some 12,000 Indiana Standard employes, Knight pleaded with the Whiting workers not to take the "entirely inadequate" offer. Knight contends that there is more to be had if his union puts economic pressure on petroleum employers.

It stands to reason that IPWA acceptance has caused larger unions to wonder if their own programs will even get started. The next day after the Whiting acceptance, members of Central States Petroleum Union, huddled with representatives of the powerful OCAW. There is no doubt that the two groups felt out the possibilities of a concerted action in the event of a strike.

Other unions have also met with the OCAW to discuss cooperation on a wage acceptance. The only group which has refused to take a position on the matter is the Federation of Independent Oil Unions which was formed last year to keep independent organizations from being inhaled into the giant OCAW.

Knight, whose union wants a 27-cents an hour wage hike, warned oil companies that if they do not make a reasonable offer by the end of April, 90 percent of the striking force could walk out under wage reopening clauses.

Refinery Plans Gain Ground

The planning advisory Commission of Calgary, Alberta, Canada has approved the application of Imperial Oil for the rezoning of a 260-acre tract to permit a $17 million expansion and modernization of the company's refinery. On the other hand, Ogden District residents who have been objecting to the rezoning say that they plan an immediate appeal to the Alberta Planning Commission.

At the same time, Mayor Don McKay plans to place before the City Council, numerous proposed concessions to Ogden residents in order to make the expansion program more attractive. The proposals include the possibility of a new community center swimming pool and park, as an inducement for residents who might ask the company to camouflage the refinery as much as possible.

Octane Ratings Up Slightly

Gasoline on sale at service stations in March rose to national weighted averages of 97.5 octane number for premium and 90.5 octane number for regular, according to the latest monthly survey of anti-knock quality compiled by Ethyl Corp.

The premium gasoline average was 0.2 octane number above the February level and 1.1 octane numbers above a year ago. The regular gasoline average was up 0.1 octane number from February and 1.2 octane numbers higher than a year ago.

Average tetraethyl lead contents in March were 2.52 ml per gallon of premium gasoline and 2.00 ml per gallon of regular gasoline.

Thirty-eight of the 53 cities in Ethyl's survey reported increases over February in the average octane number of their premium gasoline, five of them by 0.5 octane number or more. Nine cities reported decreases while six cities remained unchanged. In regular gasoline, 28 cities reported increases over February in their

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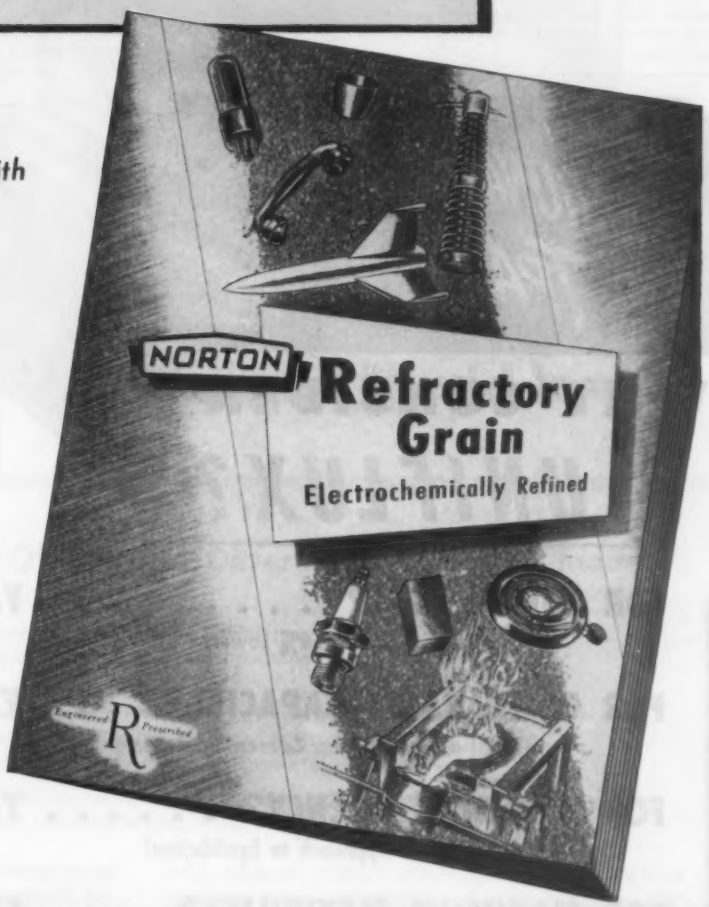
You May Profit From This Book

✓ *if you are concerned with processing that involves temperatures ranging upwards to 4000°.*

✓ *if your progress in processing depends upon materials of high purity.*

✓ *if it would help you to obtain a modern material with unusual electrical characteristics.*



Here is a valuable reference book that tells you all about the chemical and physical characteristics of such materials as CRYSTOLON* Silicon Carbide, ALUNDUM* Aluminum Oxide, MAGNORITE* Magnesium Oxide, Fused Zirconia and Boron Carbide.

Describing how these electrochemically refined materials react under varying conditions, this book gives you plenty of facts on materials that are helping to solve processing problems.

Get this useful help towards solving your own processing problems. Write today for your free copy of "Norton Refractory Grain." NORTON COMPANY, Refractories Division, 463 New Bond Street, Worcester 6, Mass.

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average antiknock quality, eight of them by 0.5 octane number or higher. Seventeen cities reported decreases, and eight cities remained unchanged.

Compared with the nationwide premium average of 97.5 octane number, 20 cities reported premium averages of 98 octane number or higher. In regular gasoline, 16 cities showed average octane ratings of 91 octane number or higher, compared with the national weighted average of 90.5 octane number.

Ethyl's survey is based upon approximately 850 gasoline samples purchased each month at service stations in the 53 marketing centers.

Better Use of Oil and Gas

Generation of electricity and other boiler uses represent the least desirable applications for both oil and gas. This is the contention of Bureau of Mines director, Marling J. Ankeny.

Ankeny told a recent meeting on atomic energy in Philadelphia that, "considerable progress has been made in reducing the use of oil and gas as boiler fuel, and we can look forward to a continuation of the trend."

He added, "It is apparent that adequate coal reserves are readily available to meet the anticipated growth needs of the electric power industry and all other demands during the next 20 to 25 years.

"We may look forward to a shift from the petroleum and natural gas that now contribute about 30 percent of the fuel for electric generation to increased use of coal, but there will be adequate supplies of this latter fuel and they should be available at relative prices approximating those of today.

"Petroleum and natural gas will be used for purposes for which they are most singularly suited and less for purposes that can be supplied by coal."

Sun Oil Uses Rolling Lab

A laboratory-on-wheels which can be "plugged in" to operating refinery units to collect data on the efficiency of their performance, has been developed by Sun Oil Co.

The mobile laboratory contains high-speed electronic computing equipment, including a data logger and frequency response apparatus, to analyze cause and effect in control operations. It has been used at the company's refineries at Marcus Hook, Pa., and Toledo, Ohio. The information obtainable with this new tool opens up an approach to the solution of plant design and operating problems having great potential value to the company, the report states.

Danger of Probes Cited

Unless the oil industry meets "the challenge" of current Washington probes with a "forceful explanation of the facts, investigations could easily lead to economic strangulation. These are the words of D. L. Connelly, API production vice president as he spoke before the Southwest district recently."

Connelly went on to say that, "Ill considered and highly dangerous political ideas may spring up and flourish, choking out the valuable fruits of the long past experience of the industry."

"The result might create economic conditions that would strangle the industry's efforts," he added.

U. S. Reserves Increase

Substantial increases in this nation's proved reserves of crude oil, natural gas liquids, and natural gas, were chalked up again last year, despite production and consumption levels that surpassed all previous highs.

This was announced by the American Petroleum Institute and the American Gas Association in the joint report which they make annually on the status of these resources.

Committees of both associations met recently in the Southwest. Their proved reserves report for the calendar year ending December 31, 1956, contains these highlights:

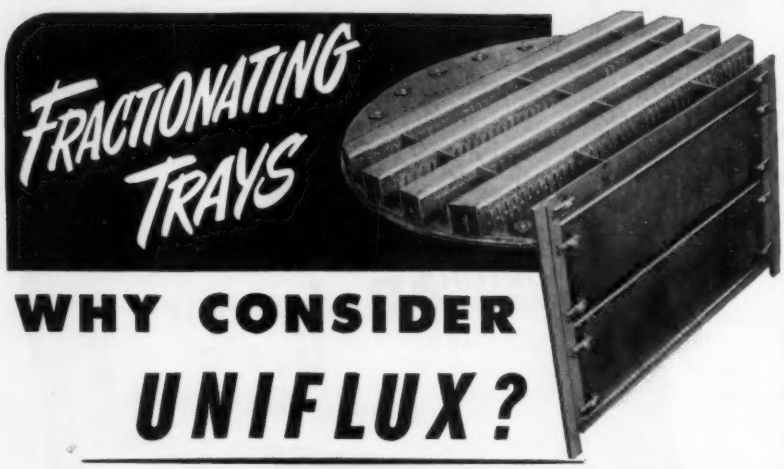
Crude oil: 30 billion 434 million barrels, up 422 million barrels over the 1955 peak.

Natural gas liquids: 5 billion 902 million barrels, up 464 million barrels.

Total liquid hydrocarbons (crude oil and natural gas liquids) 36 billion 336 million barrels, a net increase of 886 million barrels over 1955.

Natural gas: 237 trillion 774 billion cubic feet, up more than 14 trillion cubic feet.

Proved reserves of liquid hydrocarbons and natural gas are those underground supplies whose locations have been established and estimated, and which are known to be available for production. The reserves committees give no consideration to the millions of acres of U. S. lands known to be favorable to the accumula-



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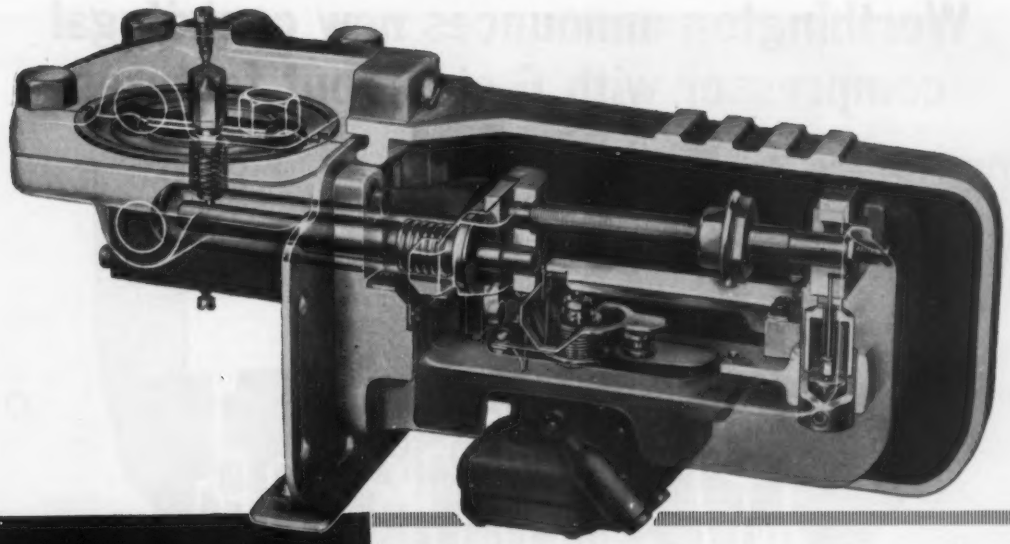


For full-range control of flow and liquid level

...there are now three HONEYWELL *Differential Converter* models

1. *For measuring gas and water flows:* The new model has a range of 0-5 to 0-25 inches of water. It can also be adapted to the measurement of specific gravity of liquids in open tanks.
2. *For measuring liquid level in closed tanks:* One model has a range of 14 to 50 inches of water, with maximum suppression of 75 inches. Another model, with a range of 50 to 200 inches of water, has maximum suppression of 200 inches.
3. *For measuring flow and liquid level in open tanks:* Two models with ranges from 0-20 to 0-200 inches of water differential and 0-100 to 0-1000 inches.

A mercuryless remote pneumatic transmitter with a range that is continuously adjustable between 0-5 and 0-25 inches of water has just been added to the Honeywell *Differential Converter* line. Now you can choose a standard transmitter for any range from 0-5 to 0-1000 inches of water . . . a choice of ranges offered by no other manufacturer.

The *Differential Converter* measures gas and liquid flow or liquid level with accuracy within ±1% . . . and with rapid response, upscale and down. Range is continuously adjustable in the field, without parts change, and field calibration check is easily accomplished with weights. Air consumption is extremely low.

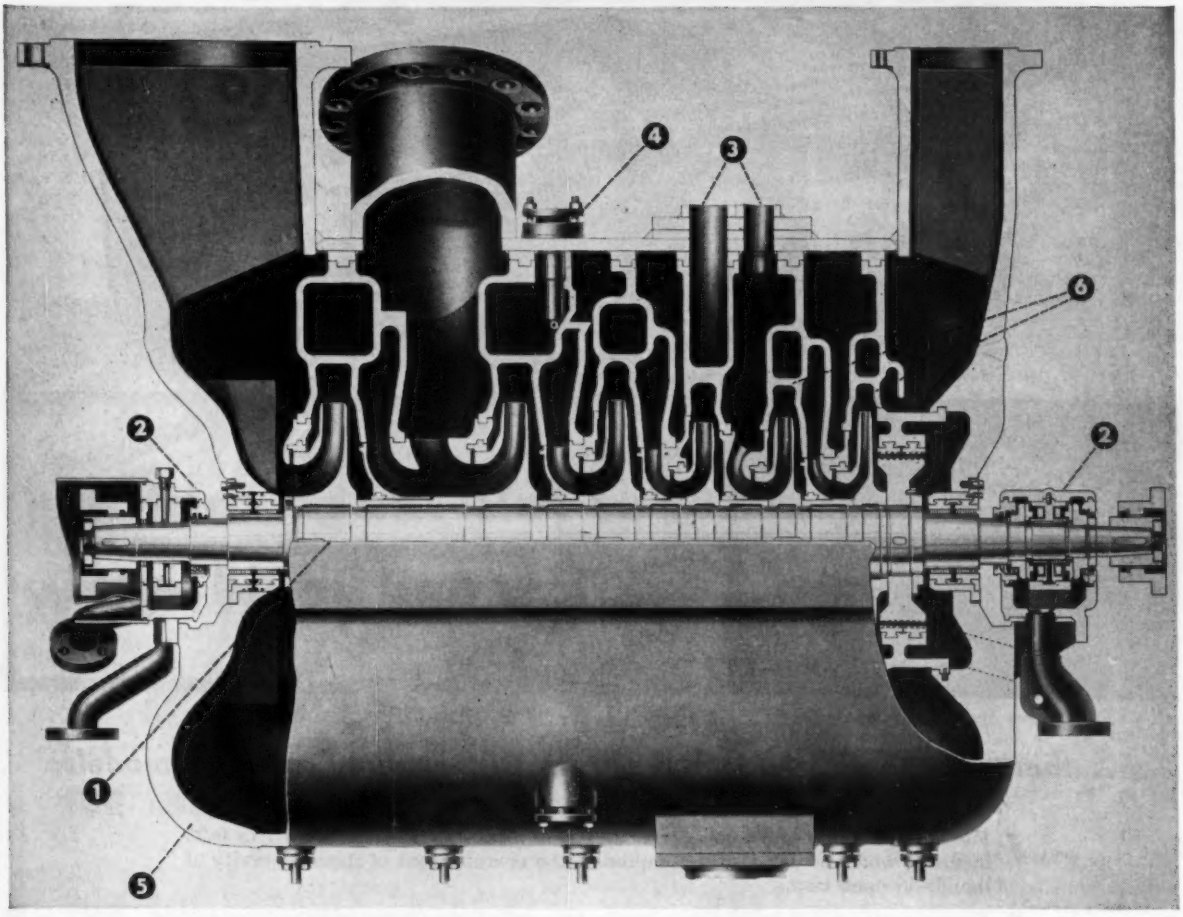
Compact and lightweight, these transmitters can be mounted anywhere. They're ideal companions for Honeywell *Tel-O-Set* miniature instruments. Call your nearby Honeywell sales engineer for details. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Phila. 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA:** Write for Bulletin 2290-1, "*Differential Converter* Liquid Level Transmitter"; Catalog 2321, "Flow Meters," and Specification 248, "*Differential Converter* Flow Transmitter."

MINNEAPOLIS-Honeywell
BROWN INSTRUMENTS
First in Controls

Worthington announces new centrifugal compressor with 6 stand-out features



Worthington's GUR multi-stage compressor is the result of intensive surveys conducted among the nation's leading industrial engineering, maintenance and operating personnel. Their recommendations, plus Worthington's famous high quality standards of manufacture and design, have combined to produce this advanced compressor!

The GUR—characterized by maximum accessibility plus ease of installation and maintenance—offers you:

1. Casings and diffusers horizontally split at centerline with no bolting of the diffusers to the casing. This design guarantees maintaining pre-established internal clearances during reassembly. It also simplifies your installation problem and permits much greater ease of maintenance and inspection.

2. External Bearings. Mounted completely external to the casing and open to atmospheric pressure. Bearing maintenance and inspection is simplified. Bearing oil is prevented from contaminating the gas being compressed.

3. Accommodations for large bleed-in bleed-out flows permits handling of different levels of refrigeration or stepwise compression of process loads and knockouts with one compressor casing.

4. Liquid injection cooling reduces heat of compression. It eliminates need to dismantle compressor to clean water passages and maintenance associated with exchanger bundles.

5. Castweld fabricated design insures known sound components from basic materials to finished product. Customer benefits because we can control tolerance between calculated designed compressor weights and actual finished weights. Castings are small and inspected before assembly. There's less scrap risk—shipping dates are realistic.

6. Horizontally split enclosed diffusers allow continuous gas guidance through compression range. Compressor casing is not used as part of diffuser. Should corrosion or erosion occur, only a particular defaced diffuser need be replaced—not entire casing.

The Worthington Multi-Stage compressor is designed for use with air, ammonia and most hydro-carbon gases. Five casing sizes give a capacity range from 570 to 82,000 C.F.M. per casing with discharge pressure to 950 psig. For details, contact your Worthington District Office...or write Section A-6121, Worthington Corporation, Harrison, N.J.

WORTHINGTON

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tion of oil and gas, but whose potential has not been developed or established.

Production of crude oil, natural gas liquids and natural gas also hit all-time peaks in 1956. The report provided these figures, for comparison:

Crude oil: 2 billion 552 million barrels, up 133 million barrels over 1955.

Natural gas liquids: 346 million barrels, up about 25 million barrels over 1955.

Total liquid hydrocarbons (crude oil and natural gas liquids): 2 billion 898 million barrels, an increase of 158 million barrels over the 1955 peak.

Natural gas: 10 trillion 908 billion cubic feet, up 790 billion cubic feet over the preceding year. Texas accounts for nearly half the nation's production and reserves. The Lone Star State's 1956 production of 5.3 trillion cubic feet was 48.9 percent of the U. S. total; its reserves at year's end were 112.7 trillion cubic feet, more than 47 percent of the total for the U. S.

The American Petroleum Institute noted that although the net results of the crude oil report are on the favorable side again, they point to the fact that 1956 was the fourth consecutive year that annual additions to proved reserves declined. New discoveries compared favorably with earlier years, API stated, but the constantly increasing output makes the net additions smaller.

Oil Vs. Gas in Homes

Natural gas will find its level sooner or later and, "the public will accept fuel oil as the foremost domestic heating source." This is the prediction of Allen J. Johnson, Lansdowne, Pa., consulting engineer and specialist in fuels and combustion.

In addressing the Wisconsin Petroleum Association, Johnson also stated that, "all signs are that the price of gas is going up and you jobbers handling heating oil will have it easier tomorrow than you have it now."

"Gas is not a fuel to be trusted in domestic heating," he added.

Pemex May Get Loan

Unless Petroleos Mexicanos can obtain "an immediate and sizable" loan, Mexican industrial growth will face a serious setback says Banco Nacional de Mexico.

Departing from the customary "pillar of Mexican economy" approach to Pemex, the bank said Pemex needs a "substantial loan" for the following reasons:

1. Pemex doesn't have the financial resources to make needed investments because of constant and growing losses.

2. Most of Pemex's income has been slated for payments to foreign oil companies whose properties were expropriated in 1938.

3. The policy of subsidizing marketing of products, especially gasoline, is antiquated and uneconomical. The bank expressed the opinion that Mexico's economical development has given the public enough buying power to face current reality.

Meanwhile, in Mexico City, Antonio J. Bermudez, general managing director of Pemex, said that Pemex has been dis-

Easy, Quick to Install

. . . that's why using Glitsch Caps and Risers will allow your unit to go on stream with a minimum installation time. The removability feature also allows cleaning to be done either inside the tower or on the ground outside. The comparatively thin-gauge metal used in Glitsch assemblies cools off and heats up rapidly, which further reduces downtime.

Over the years, we have designed more than 300 different cap and riser assemblies for every process requirement. We can furnish virtually any conceivable type and design—opened- or closed-slot caps; set-on, swaged, or pull-up risers; with wedge, quarter-turn cap, or stud hold-downs. Either round or rectangular assemblies are available in a full range of sizes and materials.

If you would like more information on Glitsch Cap and Riser Assemblies, Glitsch Truss-Type® Trays, or other Glitsch products and services, call our nearest office or write to us at P. O. Box 6227, Dallas. There is no obligation, and you will be pleased with the prompt and competent recommendations our representatives will make for your project.

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Glitsch Bubble Caps

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What's Happening . . .

cussing a loan offer with French bankers, and that prospects for agreement are favorable.

Bermudez added that there is a good chance that an agreement will be reached within the near future, but that it will be for an amount considerably less than $100 million.

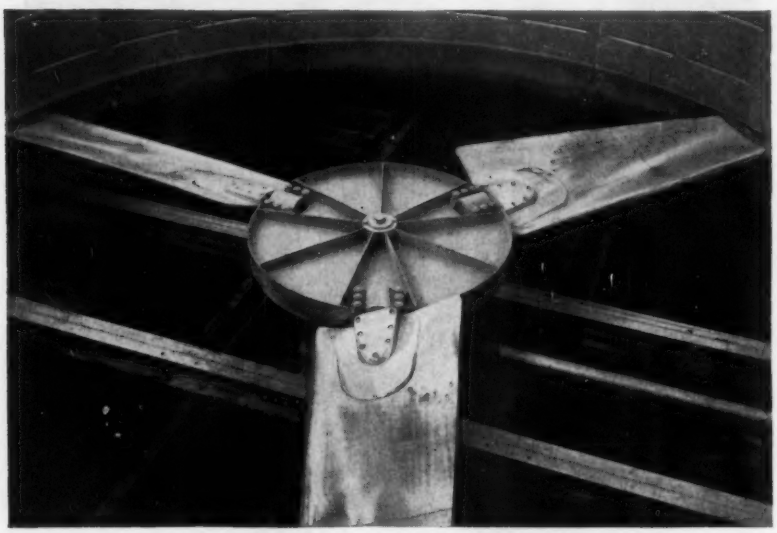
Sixty percent of the loan will be for purchase of equipment in France, but if it is not available in France, it may be purchased from the United States. Forty percent of the money will be used for labor in Mexico.

Cracker Sets New Record

A new world's record of 1065 days of continuous operation has been set by one of the catalytic crackers of the Cities Service refinery at Lake Charles, La. In establishing its champion run, extending from April 9, 1954, to March 10, 1957, the unit approached three full years of uninterrupted production.

During its record run, the unit processed 46,683,438 barrels of feed stock. It has now been shut down for inspection, necessary repairs and some modernization, a job scheduled for completion in three weeks.

The significance of this achievement, refinery executives observe, goes beyond the establishment of a new record. More importantly, it reflects the improved methods of refinery inspection and maintenance which make such continuous runs possible, thus avoiding costly production losses. To the extent that shutdowns can be avoided, and greater production obtained from present refineries, the industry, they pointed out, will have less need to invest in additional, material-consuming facilities.



HOW TO CUT COOLING TOWER MAINTENANCE COSTS

Hartzite plastic fan blades practically eliminate fan blade replacement problems in cooling towers and heat exchangers. They effectively resist corrosion, abrasion and vibration. Hartzite blades are constructed stronger to last longer. These tough, rugged blades are made of a phenolic-impregnated fabric-base material — solid construction . . . won't scale, won't peel . . . means low maintenance.

The hub section is dynamically balanced . . . solidly constructed of welded steel . . . with gussets for extra strength and increased safety.

Hartzite plastic fans are available in sizes from 10′ to 22′. Hubs are designed for 2, 3, 4 or 6 blade assemblies.

Find out more about how Hartzell helps you to cut cooling tower maintenance costs. Mail the coupon below for new bulletin A111B, "Cooling Tower and Heat Exchanger Fans".

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–Awards–

Ethly Corp. has received national recognition for helping to spread the facts about American business. The company won the **Freedom Foundation award** for its mass distribution of the pamphlet, "American Capitalism."

Ethyl is still distributing the pamphlet which clears up many misconceptions about the American system of free enterprise. So far, Ethyl has sent out 100,00 to various oil companies, 44,000 to colleges, and 175 to companies and individuals in other industries.

The annual award of the Society of Women Engineers, made to a woman who makes an outstanding contribution to engineering, **has been presented to Mrs. Rebecca Hall** Sparling, Pomona, Calif.

Mrs. Sparling is presently in the Engineering department of Convair, a division of General Dynamics, at Pomona, where she is concerned with new developments in materials and processes for the design and manufacture of guided missiles and other special ordnance weapons for the Navy.

Changing Times

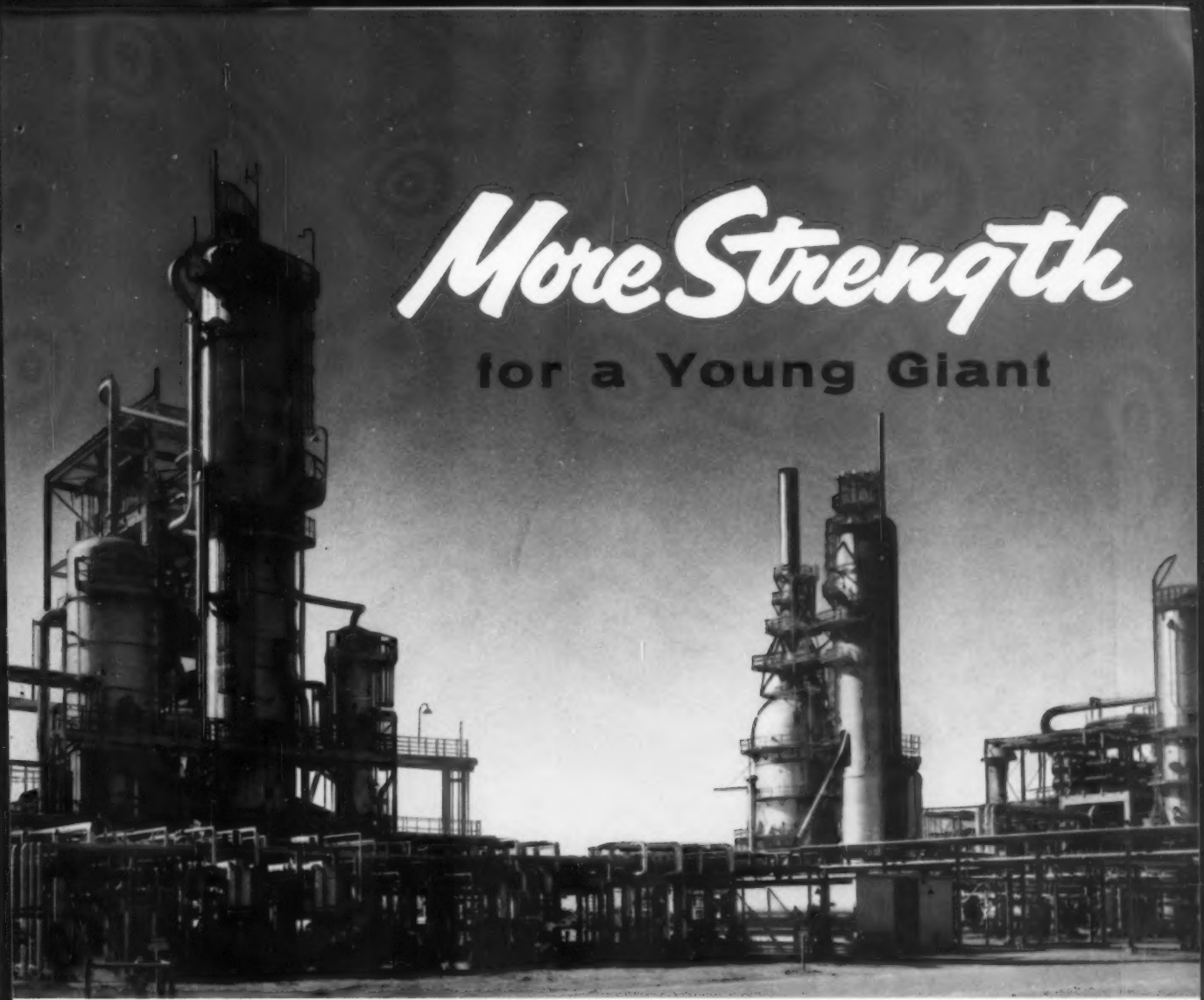
D-X Sunray Oil Co. will dismantle its 11,000-bpd plant at Allen, Okla. Refinery, which has been shut down for about two years will be sold in units or piecemeal.

Oil companies operating in Turkey **will form a Turkish Petroleum Institute to act as oil man's forum, information bureau, technical clearing house, and national trade association.** Among those represented are a dozen American firms. Proposed TPI will have four divisions—exploration and production, refining, marketing, and transportation.

Radioactive wastes may be safely buried deep in earth's rock formation. **Technique:** apply enough fluid pressure to crack the rock, then force in waste. Clay or cement added to waste helps fix the activity.

More than 20,000 Indiana-Standard employees are hearing facts and figures from company's annual report over **an usual telephonic recording in 23 cities.** By dialing a special number employees get one minute message played back.

Indiana-Standard has reported progress in rehabilitating its plant in Brownsville, Texas to make gasoline and chemicals from natural gas. **Company report claims to have overcome operating difficulties** which plagued plant when being operated



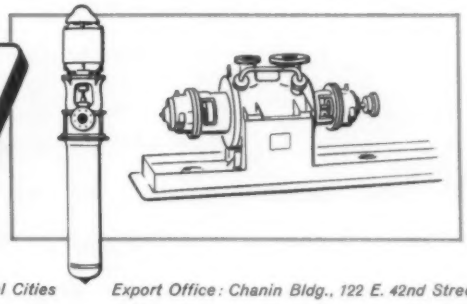
Photograph courtesy of The Lummus Company

SUNTIDE REFINING COMPANY—now only three years old—is taking long steps to strengthen its position in the refining industry. The Suntide refinery at Corpus Christi, Texas, planned for 26,300 b/d when it went on stream in 1954, already has a capacity exceeding 50,000 b/d.

New refinery units now being added will result in both higher octane and greater capacity to meet the ever-increasing demand for Suntide products.

...**PACIFIC PUMPS INC.** was selected to supply practically 100% of Suntide's centrifugal pump requirements for the original refinery.

PACIFIC was selected again to furnish virtually all of the centrifugal pumping units required in Suntide's present expansion program... convincing evidence of Suntide's satisfaction in the quality and performance of PACIFIC centrifugal pumps.



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An oilman belongs at every table Pipeliners – in fact, *all* oilmen – help set the family table. Oil-based insecticides, weed killers, fertilizers, livestock dips and animal medicines help bring better fruits, vegetables and meats to market. You cook them with natural gas or electricity that oil fuels probably generated. Sometimes people who know little about oil talk loudly against our industry. That's when we oilmen should point out that at home, as elsewhere, oil serves people well. **SHELL OIL COMPANY**

What's Happening. . .

by others, and which continued even after extensive revamping. Report also made reference to heavy depreciation charges and startup expenses.

DuPont Co. has introduced new motor-oil additive to combat sludging under severe stop and go driving. New detergent works in the presence of water.

Baltimore's new tax on manufactured inventories and equipment has cleared its first legal hurdle. Consequently, **Davidson Chemical, industry leader in fight against the law, switched location** of a proposed plant from Baltimore to a southwestern city. **Also, Esso Standard laid off 175 workers** at Baltimore refinery who were assigned to construction projects. Esso says law wasn't main reason for layoff, but was "one of the considerations."

As of last July there was **underground storage space for more than 25 million barrels of products,** and capacity is continuing to expand National Petroleum Council reported . . . **military oil purchases from small refiners will be closely scrutinized** when Senate small business subcommittee reviews complaints that Pentagon "set-aside" program forces small bidders to accept exclusively low prices . . . governors of at least 14 states are pushing for **increased state gasoline taxes, and other highway-user taxes,** to finance road building programs . . .

Changes In Ownership

LaGloria Oil & Gas Co., Corpus Christi, has "substantially completed" negotiations for purchasing the stock of McMurrey Refining Co. and McMurrey Pipe Line Co., Tyler, Texas. McMurrey has thermal cracking, cat cracking, catalytic reforming, alkylation, and coking units in addition to crude distillation facilities. Motive for the purpose appears to be an effort to balance LaGloria's producing and refining activities.

Douglas Oil Co. plans to purchase two-thirds of the 200,000 share of common stock of Apex Petroleum Corp., Ltd., Long Beach, Calif. Price named was $14.85 per share. Acquisition of Apex would more than double Douglas' crude oil reserves. Douglas expected to place privately about $3 million worth of 12 year convertible debentures to finance the purchase, and to buy remaining shares of Apex stock at a later date.

Minnesota Mining and Manufacturing Co., has bought the KEL-F chemical manufacturing business from The M. W. Kellogg Co., a subsidiary of Pullman, Inc. The 3M spokesmen said their primary interest is to develop additional uses for these high temperature, corrosion resistant resins. Kellogg spokesman said the purchase would have no effect on Kellogg petroleum and petrochemical research laboratories and other manufacturing activities in Jersey City.

MEETINGS CALENDAR

APRIL 16–18	National Petroleum Association, Semi-Annual Meeting, Cleveland Hotel, Cleveland.
19	Association of Consulting Chemists and Chemical Engineers Symposium Belmont Plaza Hotel, Baroque Room, New York City.
24–26	National Gasoline Association of America, 36th Annual Convention, Rice Hotel, Houston.
25–26	The American Society of Mechanical Engineers, Conference on Management, Statler Hotel, New York.
27	American Institute of Chemical Engineers, Oklahoma Section, All-Day State Wide Meeting, College High School, Bartlesville, Okla.
28–30	Independent Petroleum Association of America, Midyear Meeting, Buena Vista Hotel, Biloxi, Miss.
29–May 1	American Oil Chemists' Society Annual Meeting, Roosevelt Hotel, New Orleans.
MAY 3	Fourth Annual Conference of Engineers and Architects, College of Engineering, Ohio State University.
13–14	Commercial Chemical Development Association, Resort Meeting, French Lick, Ind.
13–16	American Petroleum Institute Division of Refining, Midyear Meeting, Sheraton Hotel, Philadelphia.
14–16	Industrial Nuclear Technology Conference, Museum of Science and Industry, Chicago.
19–23	The American Society for Mechanical Engineers, Oil and Gas Power Conference, Kentucky Hotel, Louisville, Ky.
20–24	National Fire Protection Association, 61st Annual Meeting, Hotel Statler, Los Angeles.
23–24	Western Petroleum Refiners Association, Southwest Regional Technical-Industrial Relations Meeting, Hotel Paso del Norte, El Paso, Texas.
JUNE 6	Pennsylvania Grade Crude Oil Association, 34th Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa.
9–12	American Institute of Chemical Engineers, Olympic Hotel, Seattle, Washington.
10–28	Summer Session on Natural Gas Technology, Includes Natural Gas Production and Processing, and Natural Gas Distribution, Institute of Gas Technology, Chicago.
14–16	The American Society of Mechanical Engineers, Semi-Annual Meeting, Sheraton-Palace, San Francisco.
16–21	American Society for Testing Materials, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N.J.
19–21	Twelfth Annual Meeting for Association for Computing Machinery, University of Houston.
20–21	Western Petroleum Refiners Meeting, Mid-Continent Regional Technical-Industrial Relations Meeting, Broadview Hotel, Wichita, Kan.
24–28	American Institute of Electrical Engineers, 1957 Fall General Meeting, Sheraton-Mt. Royal Hotel, Montreal, Canada.
JULY 8–19	Short Course in Industrial Statistics for Process Industries, University of Oklahoma, Norman.
8–26	Summer Session on Natural Gas Technology, Includes Natural Gas Transmission, and Natural Gas Fuel Utilization, Institute of Gas Technology, Chicago.
AUG. 7–9	Sixth Annual Conference on Industrial Applications of X-Ray Analysis, Metallurgy Division, Denver Research Institute, University of Denver.
11–15	American Society of Mechanical Engineers, Heat Transfer Conference, Pennsylvania State College, University Park, Pa.
28–30	Analysis Instrument Committee's International Symposium on Gas Chromatography, Kellogg Center, East Lansing, Mich.

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What's Happening . . .

. . . *Among Men* in the Industry

H. J. Kennedy Elected President Of WPRA at San Antonio Meet

Harry J. Kennedy, Houston, vice president of Continental Oil Co., was elected president of the Western Petroleum Refiners Association at the group 45th annual meeting in San Antonio. Kennedy succeeds Reid Brazell, Alma, Mich., president of Leonard Refineries, who has been WPRA president since 1955.

Kennedy was born in Caledonia, Mich., where he received his elementary and high school education prior to attending the University of Washington, Seattle.

After service in World War I, he entered the oil business when he joined Marland Oil Co. Following work in various departments of the Ponca City refinery, he was transferred to marketing. He advanced to a division manager, and had charge of two field divisions before becoming manager of marketing operations in 1927. He was then transferred from Ponca City to New York as Eastern sales manager in 1929, and continued in that capacity after the merger of Marland and Continental. In 1930, he was appointed general sales manager of Conoco, and in 1936 became vice president in charge of marketing.

Kennedy has for a long time been active in the Western Petroleum Refiners Association and other industry groups. He recently served a two-year term as marketing vice president of the American Petroleum Institute.

Harry J. Kennedy

Hines H. Baker will retire as president and director of Humble Oil & Refining Co., Houston, on April 29. He has been proposed for membership on the board of Standard Oil Co. (New Jersey) succeeding J. E. Crance who will not be a candidate for reelection.

Baker

Baker has been president of Humble since May, 1948, a director since February, 1937, and an employe for more than 37 years.

Baker said that the principal reason he is retiring is his desire to enable thoroughly competent younger men in present executive positions to advance and assume larger responsibilities. This, he said, would make possible longer service by them in the higher executive positions with enough time before them to develop and carry forward thir plans for the company's further progress.

R. V. McGrath, Bartlesville, has been appointed staff assistant to the manager of Cities Service Oil Co.'s refining division and **J. S. Brendler** has been named head of the division's new technical department.

McGrath was first employed by Cities Service in 1926 and served at company refineries in Okmulgee, Okla., and East Chicago, Ind. At the time of his transfer to Bartlesville in 1951, he was chief refinery process engineer.

Brendler joined Cities Service's graduate training program in 1939, served for a short time in the marketing division and transferred to the company's East Chicago refinery. After serving at East Chicago and Ponca City refineries, he was transferred to Bartlesville in 1952.

Harry Haines has been named petrochemical contract engineer for the Walter Kidde Engineers, Southwest, Inc.

Haines holds a B.S. degree from the University of Illinois and an M.S. degree from the University of Pittsburgh. He has done work under a Texas Gulf Sulphur Co., fellowship at the Mellon Institute of Industrial Research at Pittsburgh.

Haines has authored many articles on chemical and petrochemical industries in the southwest. He was at one time also associated with Vulcan Engineering Division of Vulcan-Cincinnati, Inc.

Sidney A. Swensrud, chairman of Gulf Oil Corp., will retire April 23, 1957, after 30 years service in the oil industry. He started in 1928 with Standard Oil Co. of Ohio, and had become an executive vice president before joining Gulf in 1947 in the same capacity. He became president of Gulf in 1948 and chairman in 1953. Swensrud will continue to live in the Pittsburgh, Pa., vicinity. Executive responsibilities within the higher echelon at Gulf are being rearranged, and it is expected that his current post will be discontinued after Swensrud's retirement.

P. L. Robison has been appointed manager of The Atlantic Refining Co.'s refinery at Port Arthur, Texas. He succeeds **Robert Stewart,** who is retiring after forty-six years of service with the company.

B. E. Milner has also been named general superintendent at the refinery.

Robison started with Atlantic in 1926 at the Philadelphia refinery. In 1941 he was transferred to the company's Texas refinery and in 1942 was appointed assistant manager.

Milner joined Atlantic in 1939 also at the Philadelphia refinery. From 1942 until 1954 he served in various capacities in the company's Research and Development department. In 1956 he was transferred to the Port Arthur refinery as technical assistant to the manager.

A. N. Wohlwend, director of commercial development of Escambia Chemical Corp., has been appointed vice president by the board of directors. Wohlwend joined Escambia last year. For many years he has been associated with the chemical industry in production, sales, market research and development.

C. Dana McCoy, former international director and New York manager of the Rust Engineering Co. has been appointed international director of Badger Manufacturing Co., Cambridge, Mass.

McCoy

McCoy brings to Badger over 30 years of engineering, construction, and management experience, much of it abroad. Prior to his joining Rust Engineering, he was affiliated with Foster Wheeler Corp. where he started as a petroleum refinery process engineer in 1928 then was elevated to international division director in 1951. He left Foster Wheeler in 1954. Earlier, McCoy was engaged in petroleum refinery engineering and operations with M. W. Kellogg Co., and the Texas Co.

Elliott W. Atkinson, El Dorado, Ark., vice president-treasurer of the Lion Oil Co. division of Monsanto Chemical Co., has been appointed assistant to the presi-

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for conveying "Problem" Liquids and Gases!

Titeflex Hose solves scores of problems in conveying organic and volatile liquids as well as corrosive gases. Connects moving and/or misaligned machine parts, other terminal joints. Withstands high extremes in temperature, pressure. Absorbs vibration, shock, and flexing . . . with ease. Sizes 5/16" to 3" Other tough conveyance problems are solved with Titeflex flexible hose made of TEFLON* in sizes of ¼" to 1¼".

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Men in the Industry . . .

dent to handle special projects.

Atkinson, who will assume his new duties June 1, will transfer his residence to St. Louis.

A native of Maysfield, Tex., Atkinson joined the Lion Oil Co. in 1924 and served in various capacities until 1931, when he became assistant auditor. In 1934 he became general auditor, and was elected a director in 1939 and comptroller in 1940. In 1943 Atkinson was elected treasurer-comptroller and in 1955 he was elected vice president-treasurer.

Norman E. Alexander has assumed the presidency of Sun Chemical Corp., Long Island City, N. Y.

Lloyd Thompson, assistant superintendent in charge of Continental Oil Co.'s Ponca City refinery mechanical division, has been appointed to the newly created position of general maintenance engineer, manufacturing department.

Also **G. W. Willoughby,** mechanical superintendent, was promoted to assistant superintendent in charge of the refinery's mechanical division, succeeding Thompson.

Other moves saw:

Roy E. Kennedy, general craft supervisor, promoted to mechanical superintendent, replacing Willoughby; **Dale M. Tague,** division engineer, promoted to general craft supervisor, succeeding Kennedy; **S. E. Hickerson,** division engineer, Light oil division, appointed division engineer for the catalytic cracking division, replacing Tague; and **Johnie Marchesoni,** mechanical inspector, headquarters division, appointed division engineer for the light oil division, succeeding Hickerson.

Walter Dannenbaum was elected a member of the board of The Atlantic Refining Co. He was elected to complete the unexpired term of **N. S. McCausland,** a director since 1946, who has resigned. McCausland retired from active service in the company in 1955 after completing nine years as treasurer.

Dannenbaum has for many years been affiliated with E. I. du Pont de Nemours & Co. in Wilmington and since 1948 has been a vice president, a member of the executive committee, and a director of the du Pont Co. He holds a B.S. degree from the University of Pennsylvania and did post-graduate work in physical chemistry at the Technische Hochschule, Charlottenburg, Germany.

Robert Q. Sharpe, staff engineer of the industrial division of the lubricating department at Socony Mobil Oil Co., Inc., New York, has been appointed chief engineer of the department.

Sharpe, a mechanical engineer and a graduate of the University of Kansas, joined Socony Mobil in 1942 as a lubricating engineer. In his new assignment he succeeds **A. C. Stutson** who has been named assistant manager of publications and training for the department. He is a native of Neodesha, Kans.

L. W. Newton has been appointed assistant to the vice president—Research, of Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp.

Newton joined Union Carbide in 1941 in the Research department of Carbide and Carbon Chemicals Co., at South Charleston, W. V. His work since then has been in organic acids, plasticizers, and nitrogenous substances. He was made a group leader in the department in 1951 and appointed assistant superinttendent of research in 1954. He has been engaged principally in administrative duties at Carbide's Research Center in South Charleston until his current promotion.

Hugh Miller, former president of the Corpus Christi Refining Co. and for 17 years general superintendent of refineries for Phillips Petroleum Co., has joined Kerr-McGee Oil Industries, Inc., as manager of the company's Wynnewood, Okla., refinery. Miller was educated at Connors State School of Agriculture, Warner, Okla. Immediately prior to joining Kerr-McGee, he had been active as a consultant for refineries and gasoline companies in and around Houston.

William N. Pauley has been made a partner of H. E. Bovay, Jr. Consulting Engineers. Pauley has had charge of the Spokane, Washington, branch office of the firm since its establishment in March, 1954. He will continue in that capacity with greater responsibilities as a partner.

A resident of Houston from 1949 to 1954, Pauley graduated from the University of Idaho in 1937. His engineering experience includes seven years in research, design and development with Standard Oil Co. of California; five years as technical director and sales manager of Farr Co. of Los Angeles; and four years as co-owner of Marshall, Neil and Pauley, Inc. manufacturers' sales and service representatives in Houston.

Russell D. Richardson has been elected treasurer of Tidewater Oil Co. in addition to his present responsibilities as controller. Richardson started with the company 36

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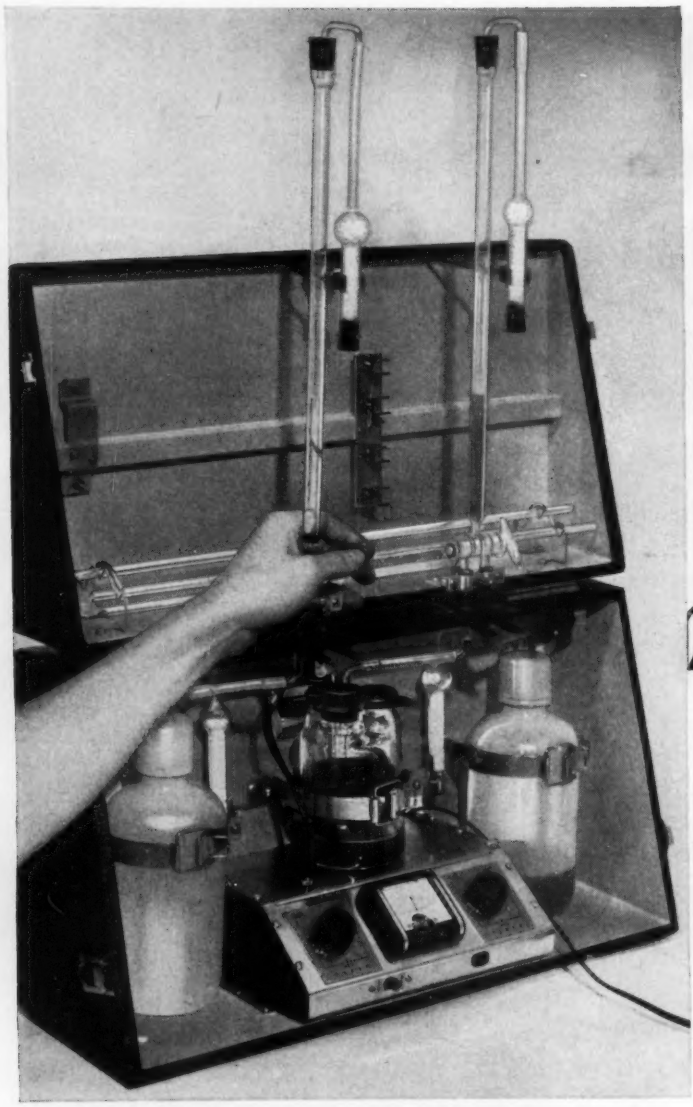

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Men in the Industry . . .

years ago as an accounting clerk at the Avon Flying A refinery near San Francisco. He became chief accounting clerk in 1927, advancing to assistant regional controller of Tidewater's western division in 1936. He served as regional controller from 1939 to 1954, then was named controller for the company.

L. Wayne Hicks, Yorktown, Va., has been appointed assistant director of American Oil Co.'s General Engineering department. In his new post, Hicks will be responsible for assisting **R. H. Koehler** with departmental supervision, establishing construction control methods and procedures, and supervising all construction in the company's six refineries.

Hicks

Hicks, a native of El Campo, Texas, joined the company in 1948, shortly after his graduation from Texas A. & M. with a B.S. degree in mechanical engineering. He was senior construction and mechanical engineer at the Texas City refinery in February, 1955, when he moved to Virginia as project inspector for the company's new Yorktown refinery.

Dr. Irving D. Webb has been appointed manager of the Chemical Research division of the Union Oil Company of California's Research department. In this capacity he will be responsible for research and technical service in the petrochemical product activities of Union and particularly Union's wholly-owned subsidiary, Brea Chemicals, Inc.

Erhart K. Drechsel has joined Escambia Chemical Corp., from American Cyanamid Co., where he was a product manager in their New Product Development department. Prior to this, he was a senior market analyst in Cyanamid's Market Research department and had spent a number of years as a research chemist in their Stamford Research Laboratory.

Drechsel holds an A. B. degree from Drew University and an M.S. degree from Syracuse University.

Henry Marchman has been appointed research associate at the Whiting, Ind., laboratories of Standard Oil Co. (Indiana). He will serve in the chemical products division. Dr. Marchman joined Standard in 1954 as a chemical engineer. He holds degrees from Georgia School of Technology and Carnegie Institute of Technology.

Walt. L. Treadwell has been appointed chief engineer of Pacific Coast Engineering Co., Alameda, Cal., designers, engineers and fabricators.

Claude Trotter, chief maintenance consultant of Phillips Petroleum Co.'s refining department, has been promoted to the newly created position of director of the employee development division in the company's employee relations department.

In his new position, Trotter will devote

→ **years** to your piping

→ **gallons** to your flow

→ **strength** to an otherwise weak link

add → **BONNEY WELDOLETS**

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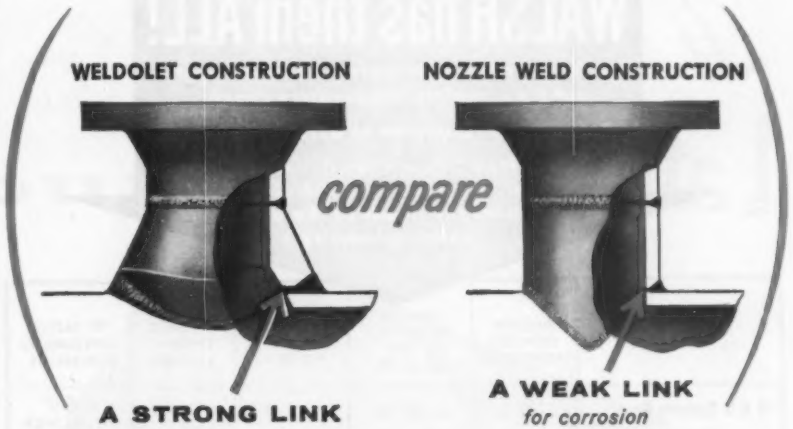

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Men in the Industry . . .

his full time to the effective development and utilization of Phillips manpower resources and will coordinate departmental procedures and techniques for over-all company training and development.

Born at Kansas City, Kans., Trotter graduated from the University of Kansas with a B.S. degree in civil engineering and started work at Phillips' Kansas City refinery in 1938 as a student engineer. He advanced through various positions in the refining department until March 1950 when he became chief maintenance consultant.

William J. Abnett has been appointed assistant project engineer in Sun Oil Co.'s Manufacturing department. He previously served as assistant technical adviser on natural gas and natural gasoline projects in Sun's Production department.

Abnett's new duties will concern plant construction supervision. Additionally, he will specialize in boiler installations, steam and power systems, circulating water systems and installation of cooling water towers.

Abnett graduated from the University of Wisconsin in 1948 with a B.S. degree in mechanical engineering. He joined Sun in May, 1949, as a special assistant in the Natural Gas department in Philadelphia.

John H. Eiseman of the Gas Chemistry section of the National Bureau of Standards has been given the "Award of Merit" of the Operating Section of the American Gas Association. The honor recognizes Eiseman's contributions to further the interests and promote the welfare of the industry and of the public.

Well known in his field, Eiseman's work at NBS centers around research on the physical and chemical properties and the utilization of fuel gases. This work includes the fundamentals of burner and appliance design, the effect of variations in gas composition on the safe and efficient utilization of gases, heating value and specific gravity as well as a number of related areas. Much of this work has been in association with the American Gas Association.

Eiseman also serves as a consultant to the American Standards Association, the National Fire Protection Association and other government and state committees and organizations.

Braeckel

Kimball

Marc F. Braeckel and Thomas B. Kimball have been elected executive vice-presidents of Sinclair Refining Co. Both were formerly vice presidents. Braeckel will continue as director of marketing of the company, while Kimball will continue as director of manufacturing.

Ahearn

James A. Ahearn, vice president and director of transportation, supply and distribution, has been elected executive assistant to James E. Dyer, president.

James D. Harris has been elected vice president and general counsel of The Fluor Corp., Ltd.

Harris, formerly chief counsel, has been with Fluor for the past six years. Before joining the company, he was associated with the law firms of Forster & Gemmill and Meserve, Mumper & Hughes of Los Angeles.

A graduate of Stanford Law School in 1948, Harris was admitted to the California Bar in 1948 and the U. S. Supreme Court in 1955.

Edmund Field has been appointed senior research associate and **Herbert N. Friedlander** has become group leader at the Whiting, Ind., laboratories of Standard Oil Co. (Indiana). Dr. Field will coordinate work on olefin polymerization

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Super Castable No. 32	3000° F.	125 lbs.	131 lbs.	4660 PSI	65% of fireclay brick
Lite-Wate Castable No. 50	2100° F.	50-52 lbs.	62-64 lbs.	800 PSI	16% of fireclay brick
Lite-Wate Castable No. 50 NISF	2000° F.	48-50 lbs.	51-53 lbs.	800 PSI	16% of fireclay brick
Lite-Wate Castable No. 70	2300° F.	70-72 lbs.	80-82 lbs.	820 PSI	20% of fireclay brick
Lite-Wate Castable No. 22	1600° F.	22 lbs.	22 lbs.	60 PSI	8% of fireclay brick

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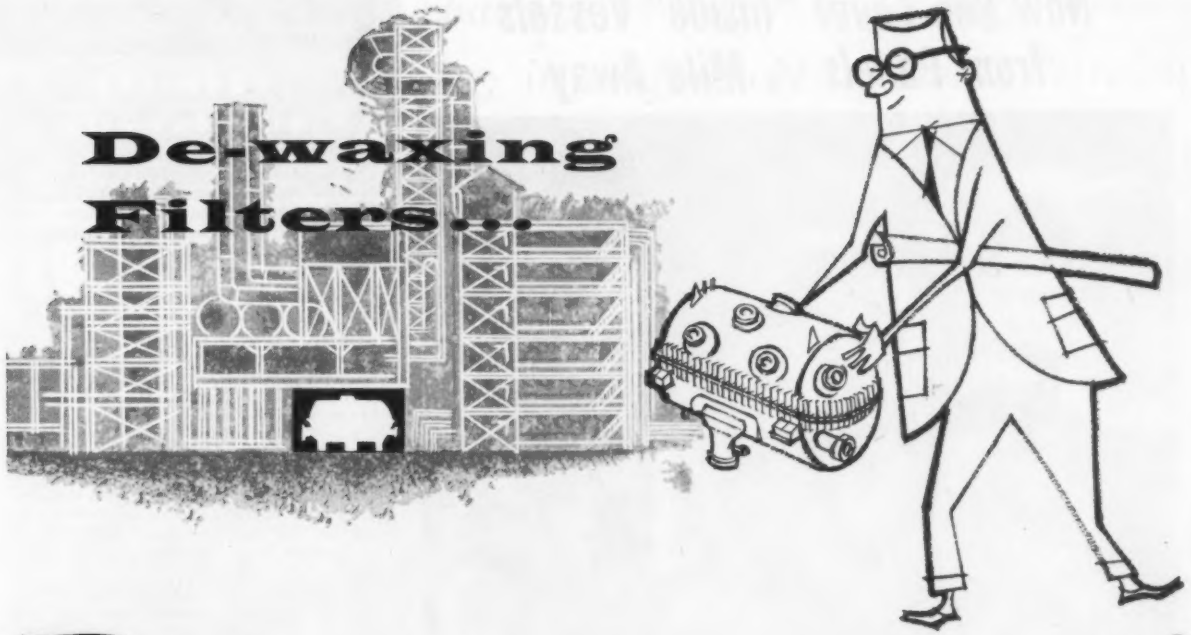

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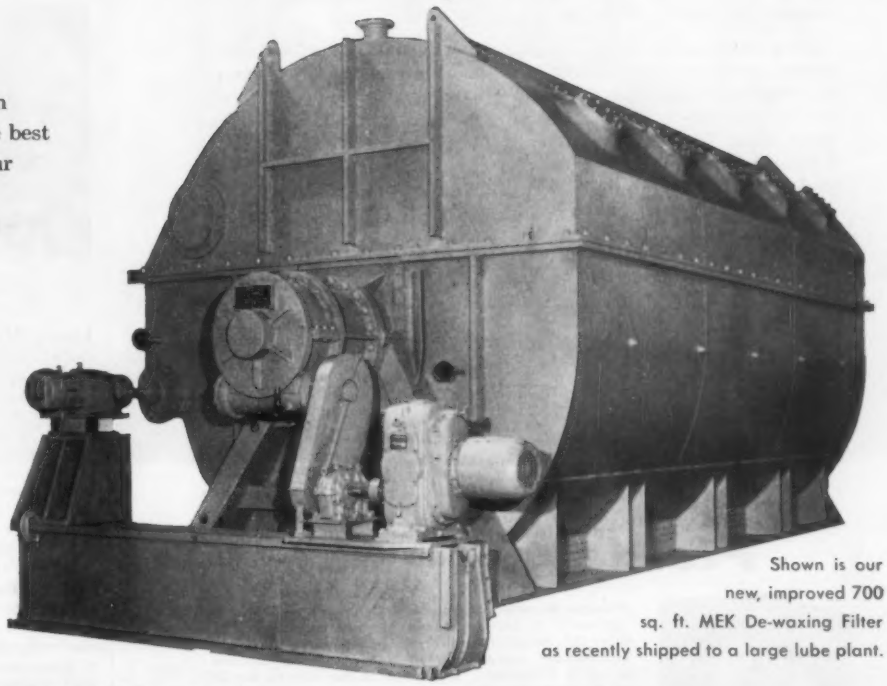

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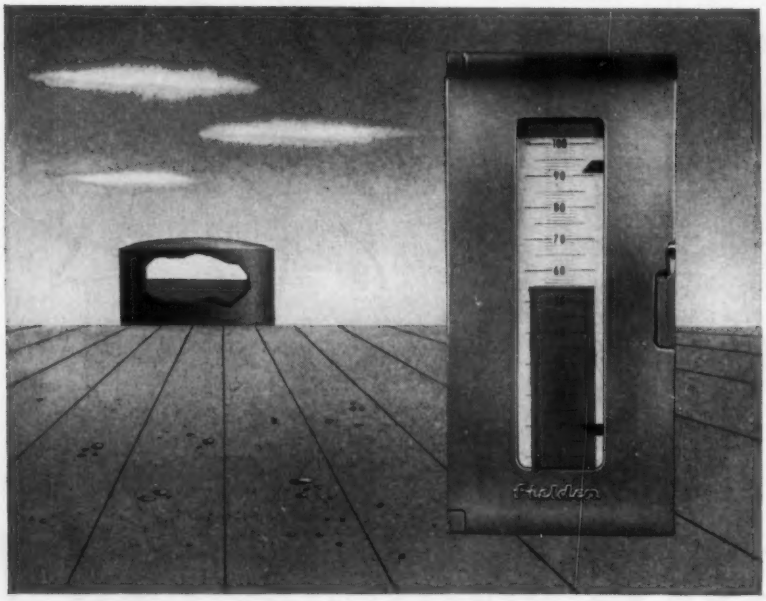
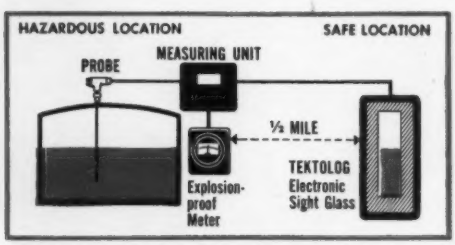


With a new Fielden unit, the level of any liquid, powder, interface, or granular solid can be measured accurately in any area . . . and reproduced visually as far as ½ mile away.

This equipment now enables you to combine all the advantages of capacitance level measurement with the convenience of 8½" vertical scale indication and control. Level is measured and indicated locally and/or remotely by a Fielden Series 10 TELSTOR, Series 42 Null Balance or Series 16 Continuous Level Telemetering System. A TEKTOLOG Electronic Sight Glass of panel space-saving design then shows level graphically by means of a moving colored tape.



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Men in the Industry . . .

related to high polymers. Dr. Friedlander will continue work on polymerization.

Dr. Field joined Standard in 1948 as research associate. He holds degrees from Illinois Institute of Technology and Northwestern University. Dr. Friedlander, who did undergraduate and graduate work at University of Chicago, joined the company in 1948 as chemist.

C. W. Lyon, design engineering supervisor at the Ohio Oil Co.'s Robinson, Ill., refinery, has been appointed supervisor of a new department to be known as the building construction and maintenance department. **T. B. Steele, Jr.,** of Robinson, has succeeded Lyon.

Lyon joined Ohio Oil in 1930 at the Robinson refinery as a clerk. After leaving for study at Purdue University in mechanical engineering, he rejoined the company and, in 1938, became a refinery engineeer. He was appointed supervisor of the design engineering department in 1953.

Steele, presently assistant design engineering supervisor, started with the company in 1946 after serving in the Army Air Force. He received a petroleum engineering degree at the University of Oklahoma in 1939.

Alfred L. Hartridge, vice president and treasurer of Stone & Webster Engineering Corp. has been elected a director of the corporation.

Hartridge

Hartridge who first joined Stone & Webster Engineering Corp. in 1931, has his headquarters in the Boston office where he is responsible for the executive direction and coordination of all activities at that location.

Leroy V. Scott has been named supervisor of employee relations at Tidewater Oil Co.'s new refinery in Delaware. Scott was formerly assistant to Tidewater's eastern division employee relations supervisor. He joined the company in 1929 as a messenger at the former Bayonne refinery. He became secretary to the employee relations supervisor in 1937, and was named a personnel assistant later that year. Scott was made an employee relations analyst in 1951 and became assistant to the employee relations supervisor in 1955.

Also, **Raymond K. Arzinger** was appointed technical foreman of the utilities and sulfur recovery area. Arzinger joined the company in 1952 as a junior engineer at Bayonne. **Charles H. Bennett** was named unit technical foreman of the cracking area. Employed in 1948 as an engineer at Bayonne, Bennett was an assistant process engineer prior to his new appointment. **William W. Burleigh** was appointed unit technical foreman of the desulfurizing and hydrogen area. Burleigh joined the company in 1943 as a chemical engineer at Bayonne.

William J. Doyle, Jr., was appointed unit technical foreman of the crude area. Doyle joined Tidewater in 1940 as a lab-

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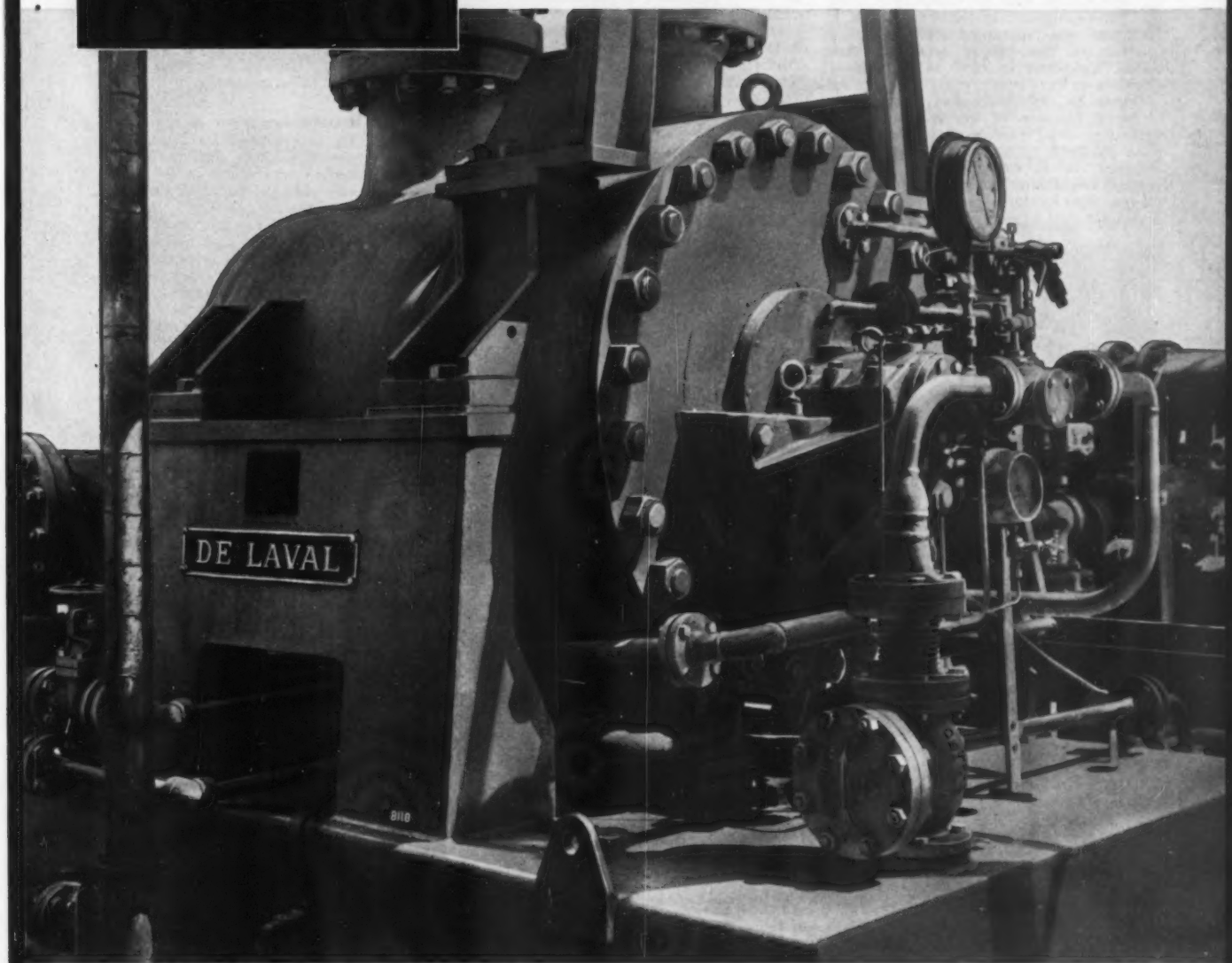
handles hydrogen under high pressures in a reformer at General Petroleum



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General Petroleum Corporation is only one of many refiners who have specified De Laval Compressors. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval. Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation. De Laval has more than 40 years of experience in solving gas compression problems.

DE LAVAL *Centrifugal Compressors*

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DL-367

Men in the Industry...

oratory assistant at Bayonne. **Laurance A. Gleason** was named unit technical foreman of the alkylation polymerization area. Gleason started with the company in 1947 as a junior engineer at Bayonne. **Edwin J. Hoffman** was appointed unit technical foreman of the coking area. Hoffman joined Tidewater in 1946 as a chemical engineer at Bayonne.

Glenn W. Wimberly was named unit technical foreman of the reforming and extraction area. Wimberly joined the company in 1946 as a junior chemist at Bayonne. **R. E. Lumpkin** was named a general coordinator. Lumpkin, a new employee, was formerly an engineer at the Texas Co.

H. C. Packard, Shell Oil Co., New York, has been named chairman of the American Petroleum Institute subcommittee on Petroleum Liquid Quantity Measurement. **A. H. Newberg,** of Service Pipe Line Co., Tulsa, Okla., was named vice chairman, and **E. O. Mattocks,** director of the Institute's Department of Technical Services, was appointed secretary.

Other members of the subcommittee are **S. D. Dalton,** Socony Mobil Oil Co., New York; **F. M. Dawson,** The Texas Co., New York; **C. W. Hubbell,** Phillips Petroleum Co., Bartlesville, Okla.; **H. F. Huf,** The Atlantic Refining Co., Philadelphia; **J. H. McClintock,** Esso Standard Oil Co., New York; **R. K. Paine,** Standard Oil Co. of California, San Francisco; **Paul Siecke,** Gulf Oil Corp., Pittsburgh, and **L. S. Wrightsman,** Humble Pipe Line Co., Houston.

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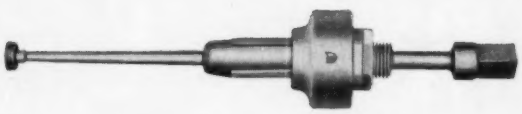

No. 255—for average tube sheets

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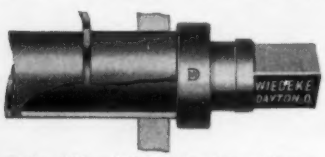

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The Gustav WIEDEKE Company
Dayton 1, Ohio

William J. Rosenbloom has been appointed director of engineering for the Chemical Construction Corp. He developed the electrolytic hydrogen cell and the atmospheric ammonium sulphate process used in many of the plants designed and engineered by Chemico.

Rosenbloom joined Chemico in 1937, and from 1952 to 1955 served as chief engineer of Chemical Construction (I.A.) Ltd., in Toronto, Canada. He is a graduate of McGill University with a B.S. degree in chemical engineering.

John H. Brown supervisor of engineering & building maintenance for Tidewater Oil Co.'s eastern division, has been appointed divisional representative to serve on a company-wide defense and disaster planning committee.

The committee will concern itself with the development of plans and procedures to function in the event of a peace-time emergency or disaster. These plans, which will fit into the national defense procedure, will be designed to offer maximum protection to Tidewater personnel and property.

Edmund Field has been appointed senior research associate and **Herbert N. Friedlander** has become group leader at the Whiting, Ind., laboratories of Standard Oil Co. (Indiana). Dr. Field will coordinate work on olefin polymerization related to high polymers. Dr. Friedlander will continue work on polymerization.

Dr. Field joined Standard in 1948 as research associate. He holds degrees from Illinois Institute of Technology and Northwestern University. Dr. Friedlander, who did undergraduate and graduate work at University of Chicago, joined the company in 1948 as chemist.

Dr. Bernard J. Gaffney has been named New York manager of The Rust Engineering Co. Prior to joining the Rust organization, Dr. Gaffney was sales manager, Industrial Chemical Processes for Chemical Construction Corp., a subsidiary of American Cyanamid Co. He was previously a project manager and engineering economist for the company and engineering assistant to vice president at U. S. Industrial Chemicals, Inc.

Gaffney

Dr. Gaffney holds a B.S. degree in chemical engineering from Northeastern University, an M.S. degree from Illinois Institute of Technology, and a Ph.D. from Columbia University. Before entering the business field, he served as chemical engineering instructor at Michigan State College.

K. R. Gerhart, Chicago, has been promoted by Continental Oil Co. from petrochemical plant superintendent to superintendent of plant operations for the company's Sherwood refining division. He will make his new headquarters at Gretna, Louisiana.

Also, **Thomas J. Karolenko,** Baltimore, assistant superintendent of the company's petrochemical plant at that location, was promoted to superintendent of the Chicago plant, succeeding Gerhart.

Robert E. Maples, process engineer for

For more data on advertised products, use Readers' Service Cards, last page.

Remarkable resistance to heat and harsh chemicals

PROPERTIES OF "ARMALON" FELTS

GENERAL

Highly resistant to strong acids and bases at all temperatures.

Unaffected by water, common fuels, lubricants, hydraulic fluids, solvents.

High anti-stick properties.

Low coefficient of friction.

For FILTERING MATERIALS—tetrafluoroethylene felts

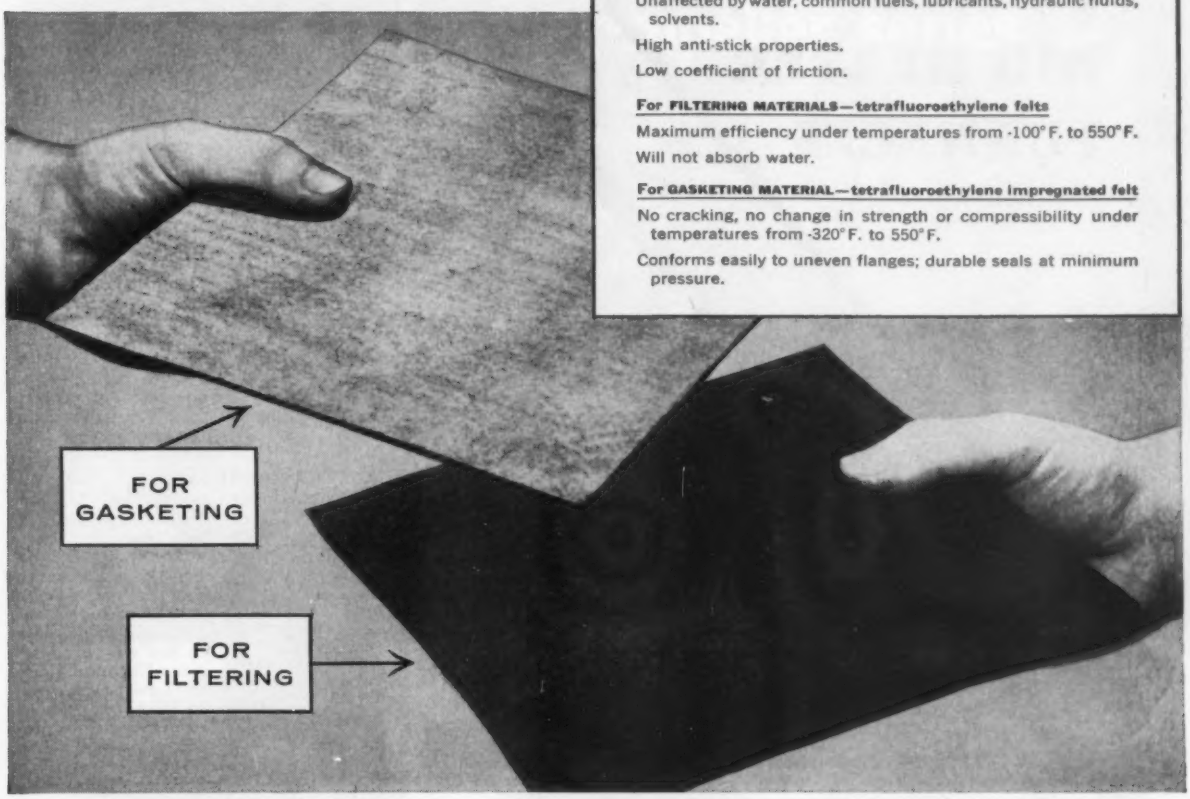
Maximum efficiency under temperatures from -100° F. to 550° F.

Will not absorb water.

For GASKETING MATERIAL—tetrafluoroethylene impregnated felt

No cracking, no change in strength or compressibility under temperatures from -320° F. to 550° F.

Conforms easily to uneven flanges; durable seals at minimum pressure.



New ARMALON® felts show exceptional service life in strong corrosives, temperatures up to 550° F.

Corrosion-resistant filters and gaskets of new "Armalon"* tetrafluoroethylene resin assure extraordinary long life felts where other materials fail entirely. They've proved their superiority in systems handling strong acids and bases—at temperatures from -320°F. to 550°F.

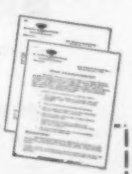
"Armalon" is the new felted form of Du Pont's "Teflon"** tetrafluoroethylene resin, available in two constructions—one for filtering, the other impregnated for gasketing†. "Armalon" is inert to water, common fuels, lubricants, hydraulic fluids, solvents and corrosive chemicals.

FILTERS of "Armalon" remove fine particles at high flow rates with minimum pressure drop. Anti-stick property of "Armalon" means longer service life, easier cleaning.

GASKETS of "Armalon" seal securely and last months, even years, longer than other materials. Advantages include substantial reductions in costly replacement shutdowns.

For more facts that may help you find a place for "Armalon" felts in your operations, fill out and mail the coupon. You'll receive Du Pont's free descriptive bulletin, including specifications.

*"Armalon" is Du Pont's registered trademark for its tetrafluoroethylene felts and impregnated felts.
**"Teflon" is Du Pont's registered trademark for its tetrafluoroethylene fiber.
†"Armalon" tetrafluoroethylene impregnated felt is covered by U. S. Patent 2,764,506.



DU PONT INDUSTRIAL COATED FABRICS

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

E. I. du Pont de Nemours & Co. (Inc.)
Fabrics Division, Dept. PR7-4
Wilmington 98, Delaware

Please send me descriptive bulletin on "Armalon" felts.

Name_____ Position_____

Company_____

Address_____

City_____ State_____

For more data on advertised products, use Readers' Service Cards, last page.

PEABODY AIR HEATER FURNACES

the right answer to your air heater problems...

FEATURES:

BURNERS– only ONE per furnace

FUELS– oil or gas with equally good results

CAPACITY– up to 300 million B.T.U./hr.

PRESSURE– one to 10 atmospheres

FLEXIBILITY– a wide range of outlet temperatures

PROVEN PERFORMANCE
– hundreds of units installed in process plants

Peabody Air Heaters go on the line smoothly, operate at full capacity on demand and always deliver "SPECIFICATION PLUS" performance.

PEABODY ENGINEERING CORPORATION
232 MADISON AVENUE, NEW YORK 16, N.Y.
OFFICES IN PRINCIPAL CITIES
PEABODY LIMITED • LONDON, S.W. 1, ENGLAND

7-062

Men in the Industry...

Conoco at Ponca City, was promoted to assistant superintendent at Balitmore, succeeding Karolenko.

Gerhart joined Conoco in 1947 at Baltimore where he later became supervisor of the sales service laboratory. He transferred to Chicago in 1953. He is a graduate of Lebanon Valley College, where he majored in chemistry.

Karolenko joined Conoco in 1947 at Balitmore and became assistant superintendent of the company's petrochemical plant at that location in 1952. He is a graduate of Loyola College, where he majored in science.

Maples has been with Conoco at Ponca City since 1954. Previously he served as instructor for two years at the University of Tulsa and two years as a professor in Brazil, where he was a consultant to the Brazillian Government's National Petroleum Council. A native of Tulsa, he received both his B.S. and M.S. degrees from the University of Tulsa, majoring in chemical and refining engineering.

R. C. Rohrdanz has been named assistant construction manager of Tellepsen Petro-Chem Constructors, Houston.

Rohrdanz

Formerly chief engineer and general superintendent of Bellco Industrial Engineering Co., Rohrdanz prior to that was with Monsanto Chemical Co. in St. Louis. With Monsanto, he was project manager on such projects as the $60 million Atomic Energy Plant at Oak Ridge, and the $200 million styrene plant reconstruction at Texas City.

A 1932 graduate of Kansas State with a B.S. degree in chemical engineering, Rohrdanz was assistant superintendent on crude stills, chemical treating, asphalt production for Derby Oil Co., Wichita, Kan. He then served as assistant general manager and chief engineer of Mid-Continent Quicksilver Corp., Amity, Ark., and then as refinery superintendent of operation and maintenance for Shelly Refining Co. at Bay City, Texas, before joining Monsanto.

William F. Kenney, vice president and general counsel of Shell Oil Co., has been elected chairman of the American Petroleum Industries Committee, to succeed **Robert H. Scholl,** vice president and director of Esso Standard Oil Co., who has served as chairman the past two years.

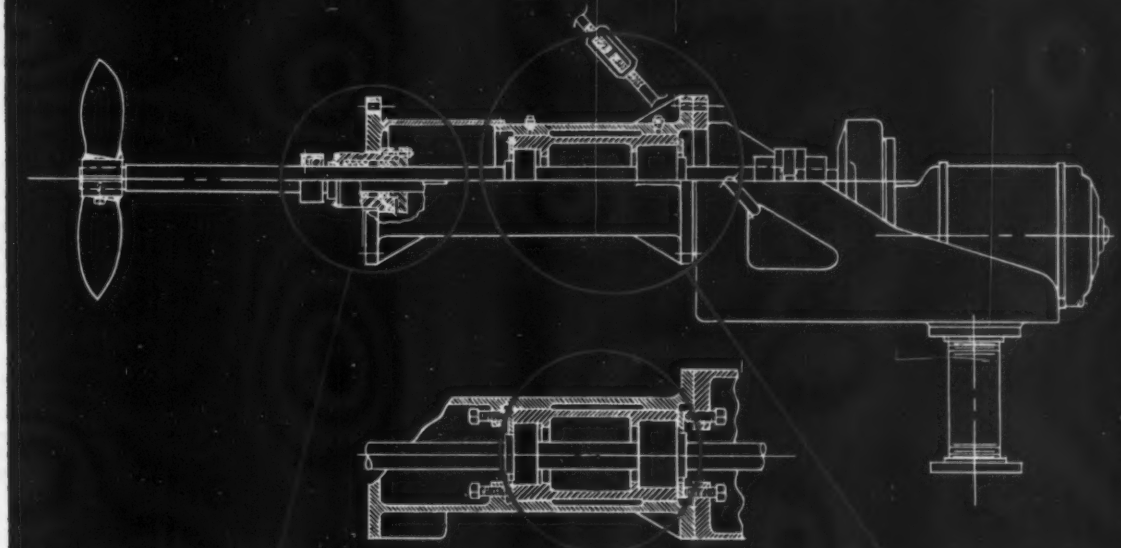
Henry L. O'Brien, general counsel and director of Cities Service Co., was elected to succeed Kenney as vice chairman.

Sir Francis Hopwood has announced intention to retire June 30, 1957 as managing director of Shell Petroleum Co., Ltd. He will remain a managing director of Shell Transport and Trading Co., Ltd., and of Shell Petroleum Co. Ltd. He also will retire as a principal director of N. V. de Bataafsche Petroleum Maatschappij.

H. Wilkinson, president of Canadian Shell Ltd., has been named a managing director of the Shell Petroleum Co. Ltd.,

For more data on advertised products, use Readers' Service Cards, last page.

announcing the new TURBO-MIXER side entering propeller series



Repackable Stuffing Box: standard in the sizes from 10 H. P. up, and obtainable in all sizes from 1 H. P., utilizing a special Turbo-designed positive seal mechanism.

Simplicity: only 2 bolts to turn to retract the bearing housing and apply the positive pressure to the sealing device, and only 2 bolts to turn and to return it to operating position. The gear-motor doesn't move an inch!

Retracting Bearing Housings: no pulling the shaft back through a bearing (which means a loose shaft-to-bearing fit). In the Turbo, the complete housing retracts, leaving the bearings untouched, in perfect shop-fitted alignment, keeps them that way.

Expertly designed, based on 44 years of specialized experience. The simple, sturdy design of this new series of Turbo-Mixers makes servicing easier, reduces maintenance costs. Models are available in standard sizes from 1 H. P. to 30 H. P. in two series, AD (direct drive) or AV (V-belt). All are available with a special mechanical seal which can be replaced while the tank is full.

TURBO-MIXER GENERAL AMERICAN

TURBO-MIXER DIVISION
GENERAL AMERICAN TRANSPORTATION CORPORATION

Sales offices: 380 Madison Avenue, New York 17, New York • General offices: 135 S. La Salle Street, Chicago 90, Illinois • Offices in all principal cities

FOR DETAILED INFORMATION AND USEFUL DESIGN DATA, SEND FOR THE FOLLOWING BULLETINS:

Please send me the following Turbo-Mixer Bulletin(s):

_____Side Entering Propeller Mixer Bulletin

_____RDC Extraction Column Bulletin

_____Minerals Processing Bulletin

_____General Turbo-Mixer Bulletin

For more data on advertised products, use Readers' Service Cards, last page.

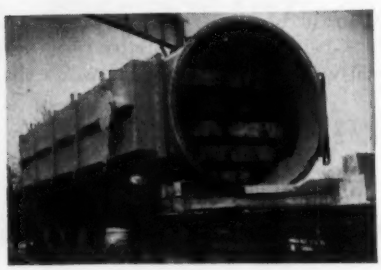
First fabricated ammonia still ...built at Downingtown for Koppers Company, Inc.

When Koppers Company, Inc., Engineering and Construction Division designed this welded carbon steel plate ammonia still to replace its previous cast iron design, it naturally chose the fabricator with care. Close tolerances were required on positioning of risers, riser slots, bells, trays and weirs. We're proud of the part Downingtown had in this pioneering effort. This still is used for stripping the ammonia from ammonia liquor produced in a chemical recovery coke plant.

THE UNIT WAS BUILT TO THE FOLLOWING SPECIFICATIONS:

Inside Diameter: 7′0″
Over-All Height: 37′10″
Design Data: 12 psi, 650° F.
Operating Data: 7 psi, 250° F.
Shop Test: 12 psi hydrostatic for 90 min.
Total Weight: 60,000 pounds

Send for bulletins describing our experience and facilities.



Interior of bottom section, showing position of rectangular bells fabricated from stainless steel, type 410. Thirteen trays, with bells.

Downingtown Iron Works, Inc.
151 Wallace Ave., Downingtown, Pennsylvania
division of PRESSED STEEL TANK COMPANY Milwaukee
Branch offices in principal cities

HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION
CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

Men in the Industry...

and a principal director of N. V. de Bataafsche Petroleum Mij.

Effective June 30, **Ian Davidson** is resigning as president of Compania Shell de Venezuela, while retaining directorship. Davidson is expected to be named president of Canadian Shell Ltd., in Toronto, and to also be named to the boards of Shell Petroleum Co. Ltd., and N. V. de Bataafsche Petroleum Mij. **G. C. K. Dunsterville** will be named president of Compania Shell de Venezuela, to succeed Davidson.

V. C. Georgescu has been named associate London Middle East representative by Standard Oil Co. (New Jersey) and will serve on the staff of **P. J. Anderson,** recently named to the newly-created post of London Middle East representative. In 1954 Georgescu became vice president and director of Near East Development Corp., Jersey affiliate owning an interest in Iraq Petroleum Co.

Georgescu holds a B. S. degree in petroleum engineering and refining from Birmingham University in England. He served as president and chairman of the board of Romano-Americana, Jersey's former Rumanian affiliate. Since 1947 he has been associated with Jersey's Producing Coordination department in New York.

Horace G. Peterson has been appointed to the new position of assistant to the executive vice president of Standard Oil Company (Indiana). Peterson was assistant manager-reseller of the company's Huron, S. D., sales division.

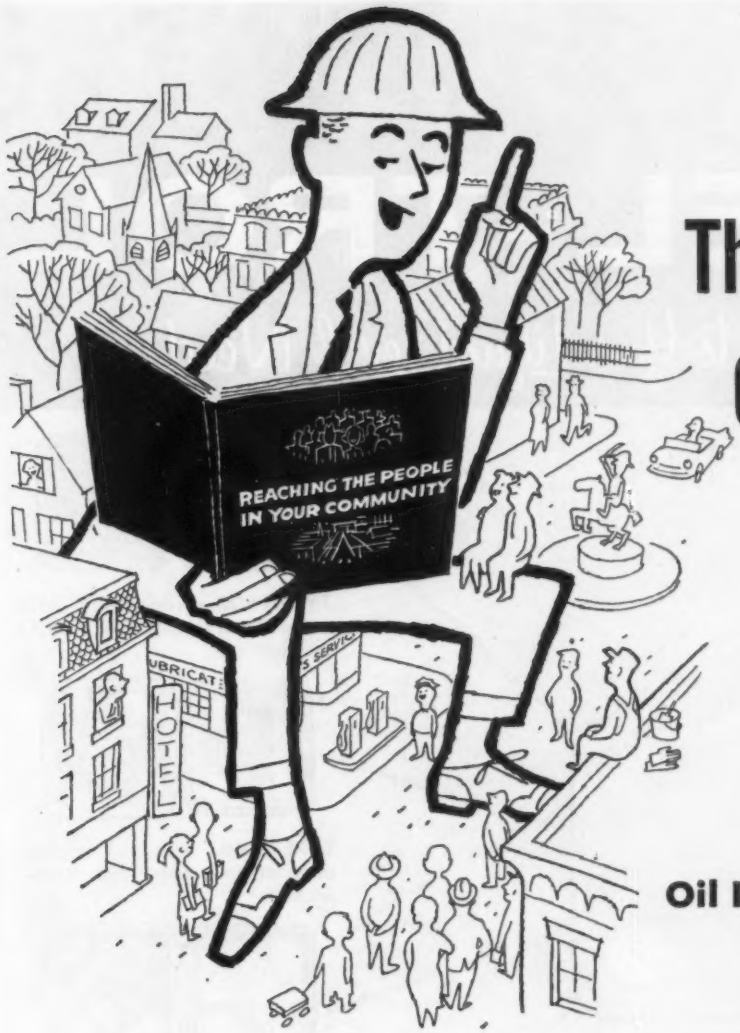
Peterson joined Standard in 1939 as a clerk at La Crosse, Wis. In 1946 he was transferred to the general office in Chicago as an aviation salesman. He was made assistant sales manager at Minneapolis, Minn., in 1948 and sales manager at Joliet, Ill., later that year. He returned to the general office as a sales manager in 1950 and was promoted to assistant manager at Huron in 1952.

– Deaths –

Carol M. Buffington, 59, died at Blanchard Valley Hospital in Findlay, Ohio, after a five-month illness. He was the supervisor of the Ohio Oil Co.'s refining and marketing accounting department.

A native of North Baltimore, Buffington joined Ohio Oil in Findlay in 1922. During his career he worked in Tulsa, Okla., and at the company's refinery at Robinson, Ill.

Harry Allison Logan, 75, a figure in U. S. refining for more than half a century died in his home at Warren, Pa. Logan was president and one of the founders of United Refining, director of the API and Pennsylvania Grade Crude Association, and trustee of the National Petroleum Association, having been its president in 1942. In World War I he served on the War Service Committee, and in World War II he was a member of the Petroleum Industry War Council.



The Best Known Oilmen Go By THIS Book

Talk oil to your town with the Oil Information Committee's new Community Program Package

If ever there was *one* public relations tool that contained all the key materials needed to build goodwill, THIS IS IT! It's the Oil Information Committee's new *Community Program Package*. And with it you can become one of the best known oilmen in your town.

Among the materials in this package you'll find something to interest every group in your community—school, farm, and women's groups; youth, civic, professional, fraternal and church organizations. Included are speeches and films, radio scripts and press releases, special demonstrations and hints on how to hold contests, stage parades, and hold "oilman for a day" events. It is the *complete* "goodwill builders" guide!

Of course you needn't be reminded how important goodwill is . . . both for you, the oilman, and your industry as well. It's a fact—the more people get to know you the more friends you make. And in your town you can help your business and your industry by telling your neighbors how petroleum helps serve their needs.

So why not take advantage of this professionally prepared, readymade community relations program. You can get your *Community Program Package* by working with the Oil Information Committee in your area:

American Petroleum Institute
50 W. 50th St., New York 20, N. Y.

I am interested in building better public relations in my community. Please send me the address of my nearest Oil Information Committee District Office.

NAME_____

ADDRESS_____

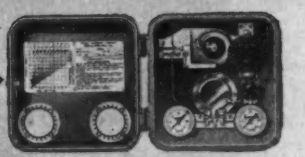
CITY_____ **ZONE**____ **STATE**_____

For more data on advertised products, use Readers' Service Cards, last page.

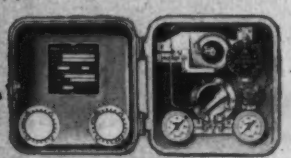
FISHER®
LEVEL-TROL

The Answer to Your Liquid Level Needs

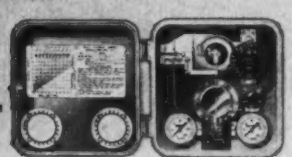
TYPE 2598—Level-Trol cage unit with 2" 600 lb. flanged top and bottom equalizing connections (F-1).



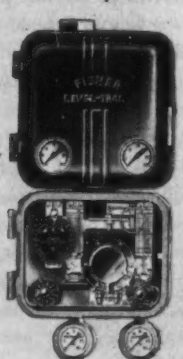
TYPE 2500—proportional pilot for general liquid level control applications.



TYPE 2500T — Level-Trol pilot used as pneumatic level transmitter.



TYPE 2500C—pilot with level indicator. Indicator available on all style Level-Trol pilots.



TYPE 2500 — 2516 dual Level-Trol pilot consisting of Type 2500 for remote level-indication or recording and Type 2516 controller with proportional and reset response.

The wide variety of pilots available for mounting on the Level-Trol gives further evidence of the Level-Trol's ability to handle practically any liquid level, interface level, or specific gravity control or indication problem.

FISHER GOVERNOR COMPANY

MARSHALLTOWN, IOWA • WOODSTOCK, ONTARIO

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER Since 1880

What Suppliers Are Doing . . .

Myers

Fred J. Myers has been appointed general manager of their Western division of Hammond Iron Works.

Myers is well known throughout steel fabricating circles having spent the last few years as Warren, Pa., district sales manager. Prior to his association with Hammond, he was with Lukens Steel Co., and before that with Welding Engineers, Inc. During World War II he served as captain in the Army Engineers Corps. He attended Pennsylvania State College, where he majored in engineering and metallurgy.

Gerstenschlager

Edward Gerstenschlager has been appointed manager of production engineering of The Babcock & Wilcox Co.'s Boiler division. Gerstenschlager's headquarters will be at the company's Barberton, O., Works.

Gerstenschlager joined B&W in 1933 as a chemist at Barberton following his graduation from Ohio Wesleyan University. He was made a service engineer in 1937 and worked in both the Cincinnati and New York districts before being promoted in 1950 to project manager in New York and Barberton. As part of his latter duties, he assisted in the design and construction of the first universal pressure boiler.

Strohmaier

Howard E. Strohmaier brings to his new position as general sales manager of the Penberthy Manufacturing Co. the selling experience gained in his more than 20 years of service with the Company. In addition to his extensive sales experience, Strohmaier has a thorough knowledge of the firm's diversified line of products as well as all other phases of its operations and enjoys a broad acquaintance in the fields which Penberthy serves.

Rick

William J. Rick has been appointed Midwest division manager of Granberg Corp., manufacturers of Granco pumps, meters and accessories. Rick's new duties include both sales supervision and consolidation of the Oakland, Calif., firm's factory cooperative plan for their midwest distributors.

Upon his appointment, Rick announced the move of Granberg's Midwest headquarters to Chicago, where there will be more warehouse space, a larger service department, and additional salesroom display area in the new location.

Hart

Howard G. Hart has been appointed St. Louis district sales manager for Harbison-Walker Refractories Co. He had been manager of the Specialties sales department, with headquarters in Pittsburgh, Pa.

A graduate of the University of Illinois, Hart joined Harbison-Walker as foreman in the Portsmouth, Ohio, Works in 1929. He became superintendent of that works in 1934 and later was named superintendent of the Portsmouth district. He has been in the company's Sales department since 1947.

O'Conner

George L. O'Conner has been appointed Southern field representative for the Stratos division of Fairchild Engine and Airplane Corp. In this capacity, he will handle the sales and service of Stratos turbo equipment, including expanders and compressors.

For the past 15 years, O'Conner has been employed by The Lummus Co., New York and Houston. For the past five years, he was engineering supervisor of the pump and compressor division of the Houston office.

Barta

H. E. P. Barta has been appointed manager of Project Engineering Sales division for The Pfaudler Co., Rochester, N. Y. In his new position, Barta will be responsible for assisting the field sales force and will cooperate with engineering department on project jobs.

A mechanical engineering graduate of Cornell University, Barta has been associated with Rheinhuette, Wiesbaden, Germany, since 1955 as manufacturer's agent in the Delaware Valley. After his discharge from the U. S. Army Air Force in 1946, he joined the Sharpless Corporation as director of overseas selling.

He is a member of the American Oil Chemists Society, Cornell Club of Philadelphia, and University Club of Mexico.

Harris

Walter A. Harris, Rumford, R. I. has been transferred from B-I-F Industries of Canada, Ltd. to the home office of B-I-F Industries in Providence. Here he is assuming the duties of sales engineer on Synchro-Scan Supervisory Control systems manufactured by Builders-Providence, Inc.

Harris was trained as a mechanical engineer at the Naval Engineering College in Canada. His previous experience includes supervisory duties in filtration plants, sales and service engineering experience, and work as a Sanitary Engineer. His professional affiliations include the Instrument Society of America, the American Microscopical Society, the Canadian Institute on Sewage & Sanitation, and the AWWA (Canadian Section).

Perier

Frank R. Perier has been elected president of the newly organized Tucson Instrument Corp., Tucson, Ariz. Perier has resigned as vice president and general manager of Technology Instrument Corp., of Acton, Mass., to take up his new duties. For the past 25 years he has been actively engaged in the production of electronic equipment.

Okie

James P. Okie, Stamford, Conn., has been appointed assistant general manager of the Plastics division of Diamond Alkali Co., Cleveland.

A veteran of 24 years' experience in the petroleum refining and chemical processing industries, Okie comes to the Diamond organization from Olin Mathieson Chemical Corp., New York, where he has been manager of economic evaluation in the Development department for the past two years.

Previously, from 1945 to 1954, Okie

NOW...effective corrosion protection

for less than

1¢

per mil foot

with CARBOLINE'S new

CARBOMASTIC

Epoxy Tar Coatings

Higher solids content (83-91%)

Thickness 5-10 mils per coat

Greater flexibility in temperature changes

Coverage 1100-1250 mil ft./gal.

Less creep in fresh and salt water

Resistant to acids, alkalies, solvents, ammonia gas, water, brine, humidity, weathering

Colors black, brown, brick red, aluminum — or can be given Phenoline 305-2 topcoat for any desired color

Some of the many uses for Carbomastic Epoxy Tar Coatings:

Chemical Processing — tank linings and pipes carrying brine, process water, cooling water; also for maintenance and equipment.

Petroleum — salt water disposal lines and wells, crude oil storage tank bottom, pipe linings, crude oil flow lines, roof top exteriors.

Marine — offshore structures, tankers, barges, steel dock structures and equipment.

Pulp & Paper — structural steel, tank exteriors — all high-humidity and condensation conditions.

WRITE TODAY for technical data and corrosion charts.
Sample bars available — please describe problem.

carboline COMPANY

345 Thornton Ave., St. Louis 19, Mo.

Manufacturers of PHENOLINE, POLYCLAD, RUSTBOND PRIMERS.

Specialists in Corrosion Resisting Coatings and Linings

Suppliers . . .

was associated with Shell Chemical Co., New York, in various executive capacities. From 1950 to 1953, he was assistant to the vice president of marketing and manager of the Industrial Chemicals department. Prior to 1950 he served in various plant supervisory positions.

Following graduation from Princeton University with a B.S. degree in engineering in 1933, he joined Shell Oil Co., at its Norco, La., refinery and subsequently worked in other Shell refineries.

TUBE REDUCING CORP., Wallington, N. J., has announced the appointment of **Industrial Products Sales, Inc.** as sales agency for their rockdrawn tubing line.

According to C. L. Megargle, general sales manager of Tube Reducing, the new agency will cover the state of Ohio, Western Michigan, and Northern Kentucky. Industrial Products Sales, Inc. maintains their main office in Akron, Ohio, and has branch offices in Cleveland and Dayton, Ohio, as well as in Detroit, Michigan.

AIR REDUCTION SALES CO. has appointed **H. C. Wallace** assistant regional sales manager of the Southern region with headquarters in Louisville, Ky. **A. C. Pease,** assistant sales manager, Louisville, succeeds Wallace as district manager.

Wallace has been with Air Reduction since 1929 and has held various posts at the Louisville office. He was appointed assistant sales manager in 1936 and became district manager in 1947.

Pease, with the company since 1947, originally joined Airco's Chicago district. In 1951, he moved to Kansas City as assistant sales manager and a year later to Louisville in the same capacity, the position he has held up to this time.

The Air Reduction Sales Co. is a division of Air Reduction Co., Inc.

GENERAL ELECTRIC CO. has announced that **Gene H. Whitfield,** until recently associated with the company's Metallurgical Products department marketing personnel development section in Detroit, has been named a Carboloy carbide cutting tool sales representative in the company's Cleveland East Central district.

His territory includes Evendale, Ohio, and parts of several states, south of Cincinnati.

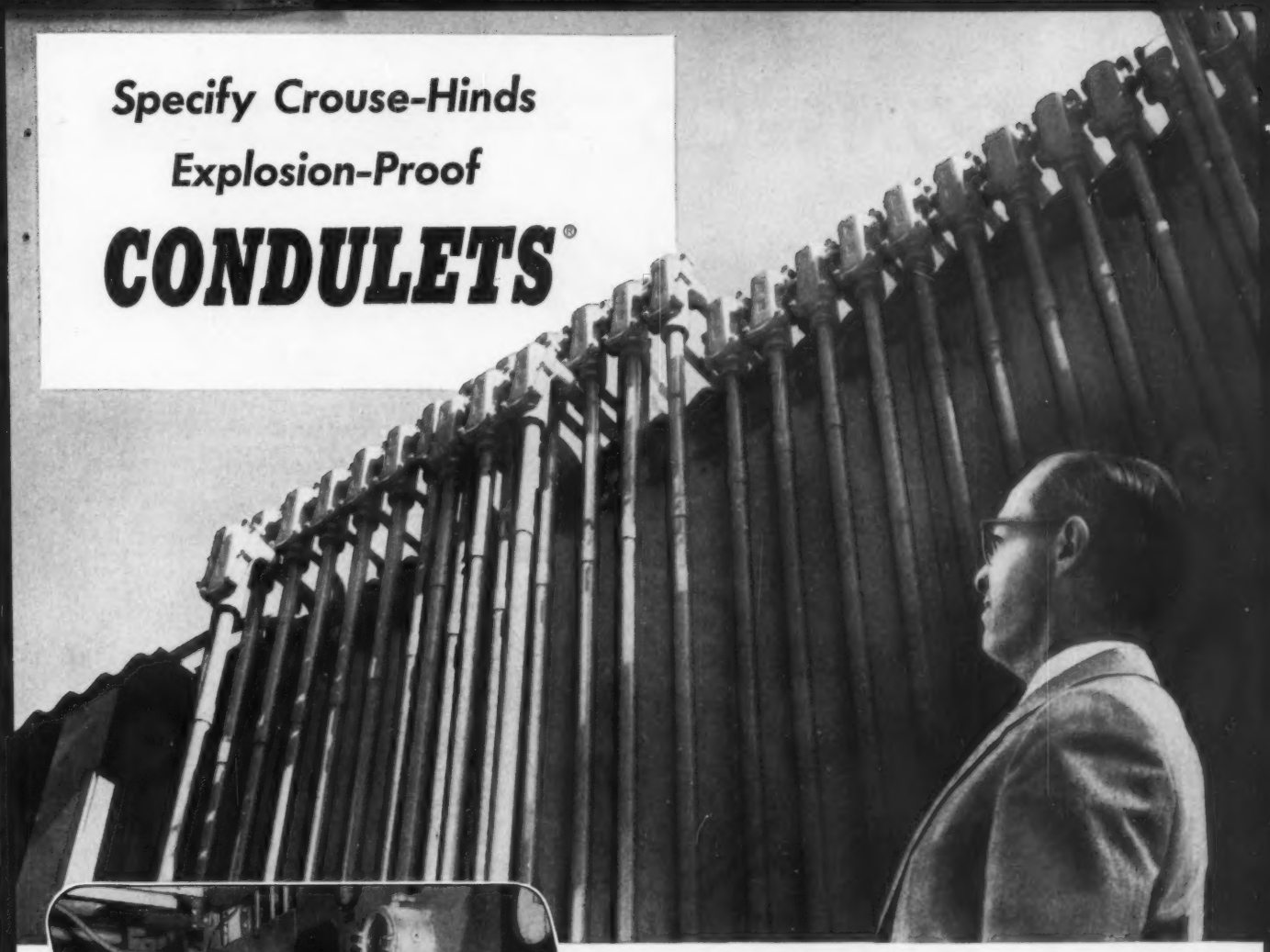
AMERICAN MACHINE AND METALS, INC., U. S. Gauge, division announced that additional distributors have been appointed in the New York and Chicago areas.

Miles W. Truesdell, formerly a field sales manager for USG, has opened the **Truesdell Co.,** Newark, N. J., to handle the USG line. In Hammond, Ind., **The Ray Welch Co.,** has added USG to his other accounts. Both distributors will carry representative quantities of stock gauges.

In Montreal, **Brian Engineering, Ltd.,** has been appointed USG agent for a portion of Ontario province, and all eastern territory including Prince Edward Island.

OLIN MATHIESON CHEMICAL CORP. has announced that **Dr. Arthur M. Smith,** assistant to the vice president, will be responsible for the direction of the anhydrous ammonia program of the Plant Food division. His headquarters will be in Little Rock. Dr. Smith has been associated with

Specify Crouse-Hinds Explosion-Proof CONDULETS®



BE SAFE! Rely on Condulets for full protection against electrically-ignited explosion—in any area classified hazardous by The National Electrical Code.

You'll find Condulet Explosion-proof electrical equipment in the nation's leading plants — from complex instrument enclosures like those on the panelboard (at left), to simple pulling elbows on the branch circuits (above). You'll like Condulet equipment because it installs easily, works right, and stays on the job for years without attention.

There are more than 15,000 Condulet items: conduit fittings, plugs and receptacles, motor controls, lighting fixtures, switches, hundreds of others, both explosion-proof and conventional. Make your selections with confidence. You get the best when you get Condulets.

Our distributors have the facts. Or contact a Crouse-Hinds Office below:

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

Main Office and Factory: Syracuse, N. Y.
Crouse-Hinds Company of Canada, Ltd.: Toronto, Ont.

Offices: Baton Rouge Birmingham Boston Buffalo Chicago Cincinnati Cleveland Corpus Christi Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Philadelphia Pittsburgh Portland, Ore. Salt Lake City St. Louis St. Paul San Francisco Seattle Tulsa Washington RESIDENT REPRESENTATIVES: Albany Atlanta Baltimore Charlotte Chattanooga Jacksonville Reading, Pa. Richmond, Va. Shreveport Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

CONSECO

Emergency

Service

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CONSECO is equipped and thoroughly qualified by long experience to repair, re-tube or re-build any type of tubular equipment, our own or of any other manufacture. Extensive facilities and personnel handle emergency assignments on the job or in our own shops. A CONSECO re-built heat exchanger is usually a better product than the original equipment because it benefits, during repairs, from our familiarity with all types of heat exchangers and of features that help to achieve longer, trouble-free, more efficient operation.

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HEAT EXCHANGERS • CONDENSERS • EVAPORATORS • STEAM JET AIR EJECTORS • CONDENSATE COOLERS • PRESSURE VESSELS SERVICE WATER COOLERS • FILTERS • STRAINERS • INSTRUMENTS, SPECIALTIES

17

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

56 BLOOMFIELD STREET HOBOKEN, N. J.

Suppliers . . .

the program in executive capacities since he joined Olin Mathieson in 1948.

WALWORTH CO. has named **Frederick M. Jackson** vice president in charge of sales.

A native of Malden, Mass., Jackson graduated from Cambridge Latin School and Bryant & Stratton Business School. He joined Walworth in 1926, becoming Eastern divisional sales manager in 1940, and vice president for oil and gas industry sales in 1952.

ROCKWELL MANUFACTURING CO. will undertake an expanded program of valve research and development **L. A. Dixon, Jr.**, vice president in charge of the company's Meter and Valve division, announced.

The valve research program, under **Russell L. Sylvester,** chief engineer for valve products, will be augmented by a new valve laboratory and machine shop at Rockwell's Central Engineering Headquarters at Pittsburgh. The new laboratory, double the original area, has been equipped for extended prototype proving.

Gettig

Sellers

ROCKWELL MANUFACTURING CO. has promoted **W. Thomas Gettig** from general manager of the Barberton, Ohio, valve plant, to assistant to the vice president in charge of the Meter and Valve division.

Gettig is succeeded by **Elton H. Sellers,** now works manager of the Barberton plant.

A native of Centre County, Pa., Gettig joined Edward Valves, Inc. of East Chicago, a Rockwell subsidiary, in 1933, and progressed through the positions of time study engineer, supervisor of methods and production manager. In 1948, he was named works manager for Edward and in 1953 he became general manager at Barberton.

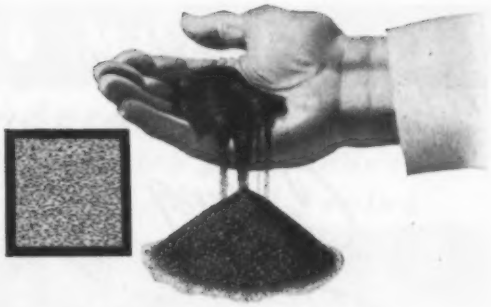
Sellers joined the Pittsburgh Valve and Fitting Co., Now Rockwell's Barberton Division, in 1936.

THE GIRDLER CO., Louisville, Ky., has invested $450,000 in the expansion of its catalyst plant. The announcement was made by W. Roberts Wood, president of the company.

Dr. Ronald E. Reitmeier, manager of the Girdler catalyst department, said the expanded facilities will increase production rates, permit the introduction of new catalysts in the petroleum, chemical and food fields, and improve manufacturing processes.

AMERICAN MACHINE AND FOUNDRY CO. has completed acquisition of two other firms, **J. B. Beaird Co. Inc.,** Shreveport,

First to lithograph drums



First to shot-blast drums

NOW!

New Rheem Centrifugal Sprayer gives you a lining completely uniform drum after drum after drum

Now, from Rheem who pioneered the improvement of drum *exteriors* by multi-color lithography, comes a new improvement for lining drum *interiors*. It's Centrifugal Spray Coating which, with Rheem high temperature curing, assures a new high in quality linings.

This method applies lining materials to drum shells without skips or misses. Every lining is completely uniform on all surfaces—won't vary from one drum to the next, one day to the next.

Above, you see the wheel-shaped business end of this new sprayer invented by Rheem. Hundreds of tiny holes puncture the wheel's edge. As this spray wheel enters the drum, it spins at a high, *constant* speed. The centrifugal force casts off a continuous, uniform curtain of finely atomized lining material.

The drum does not rotate. Only the wheel spins. The spray always travels the same distance to coat the surface. And this, plus the fact that there's no air used in the spray, eliminates air turbulence. No dust, dirt, or oil get into the linings as they do in linings applied the conventional way. Too, centrifugal spraying minimizes pinholing and blisters caused by evaporation of solvents during curing. For now lining materials with a *lower* solvent content are used.

With these new developments Rheem again leads the way by perfecting its product to better protect yours. For full details, contact our nearest office.

YOU CAN RELY ON Rheem WORLD'S LARGEST MAKER OF STEEL SHIPPING CONTAINERS

Rheem Manufacturing Company

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"FLOODED" PACKAGED LIQUID COOLERS

AEROSOL PRODUCTS
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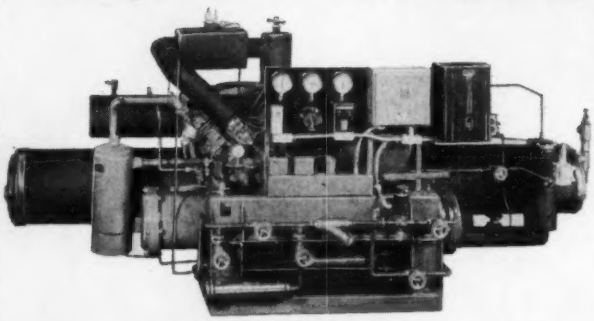
LIQUID REFRIGERANTS
METHYL CHLORIDE CONDENSING
ORGANIC ACIDS
ORGANIC SOLUTIONS
PERFUME
PRESERVATIVE SOLUTION
SALT SOLUTION
SOUP
SUGAR SOLUTIONS
SYRUP COOLING
TOMATO JUICE
VEGETABLE OIL
WINE



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Employing the flooded refrigeration principle, the coolers which are of special multipass design may be used effectively for handling viscous or slurry type liquids. The package includes a complete refrigeration cycle, completely assembled and tested, ready for quick installation and immediate operation. These units are available in a range of sizes from 5 to 100 H.P.

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DOYLE & ROTH *Manufacturing* CO. INC.

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Suppliers . . .

La., and **W. J. Voit Rubber Co.** Both companies will operate as wholly owned subsidiaries of AMF, under the General Products Group directed by **Robert W. Kerr,** AMF vice president. Officers of both companies thus integrated remain as before, with **J. Pat Beaird** as president and and general manager and **Charles T. Beaird** as vice president and assistant general manager of the Beaird firm. **Willard D. Voit** and **H. Page Parker** remain as president and executive vice president, respectively, of the Voit firm.

LUNKENHEIMER CO. has transferred **Vincent P. Mahon,** sales representative from Chicago to Houston. He replaces **Tillie C. Venable** as sales representative in the Houston territory.

Before becoming Chicago representative in 1956, Mahon was associated with the Victaulic Co. of America, Union, N. J., as midwestern district sales manager for six years.

A native of Orange, N. J., he graduated from Villanova University with a B.S. degree in mechanical engineering. He is a member of the American Society of Mechanical Engineers.

ROCKWELL MANUFACTURING CO. has named **Marshall G. Cook,** Chicago consultant, assistant product manager-liquefied petroleum gas products.

Cook spent ten years in LPG sales and promotion work for Phillips Petroleum Co. and more recently was associated with R. W. Stafford Co., Chicago, in LPG consulting, design and construction.

In other personnel changes, **Herbert M. Logan,** Tulsa district manager since 1954, has moved to the company's Pittsburgh national headquarters as manager of distributor sales. **Orville W. Barnett,** former assistant to the vice president-new products, has been named Tulsa district manager.

Barnett and Logan joined Rockwell in 1934, and both have served in various sales capacities in the Tulsa district. Logan was Tulsa office manager then in 1952 became a senior sales engineer specializing in distributor sales.

Barnett, a native of Watonga, Okla., and a 1934 mechanical engineering graduate of Oklahoma University, has been a sales engineer in the Tulsa district; district sales supervisor for gas products; and Rockwell-Nordstrom valve distributor sales manager.

LEWIS M. CROWE CO. has added **L. F. (Bill) Barnett** as a sales engineer. The Lewis M. Crowe Co. is the exclusive sales agency for Conoflow Corp. in Georgia and Eastern Tennessee.

Barnett studied mechanical engineering at the University of Florida. He served in the Navy during World War II and the Korean War, and has since been employed in the aircraft industry as a design and development engineer. Most recently he was with the Design Engineering Group at Lockheed Aircraft Corp., Marietta, Ga.

CHIKSAN EXPORT CO. has announced that **Ed T. Landgraff,** manager of the Newark branch office, has departed on an extensive journey through Latin America, which is expected to take four months.

Working closely with Chiksan representatives and customers of these countries he

CRESCENT ARMORED MULTITUBE

----------for Underground Runs

gives lowest cost with permanence for Instrument and Control Tubing

This construction of CRESCENT ARMORED MULTITUBE* may be laid in a deep trench for long underground runs without any further protection other than that offered by its lead sheath, asphalted jute, two layers of heavy galvanized flat steel armor with an asphalt impregnated jute outer covering.

The economy of this method is obvious. Also the copper tubes are completely safe from mechanical injury, and the thick asphalted jute coverings protect the metal from moisture, corrosion, earth acids and alkalies. Under road crossings where very heavy traffic is encountered, it may be buried in concrete poured into the bottom of the trench or it may be pulled through conduit.

Up to 37—¼" O.D. copper tubes may be furnished in this and several other forms of CRESCENT ARMORED MULTITUBE*, one of which should best suit your installation requirements at substantial cost savings and resulting in a better protected job. Licensed under U. S. Patent 2,578,280. *Registered Trade Mark.

SEND FOR BULLETIN NO. 356-G WITH FURTHER INFORMATION ON OTHER USES OF CRESCENT ARMORED MULTITUBE

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON 5, NEW JERSEY

CENTRIFUGAL SYNTHESIS GAS CIRCULATORS

GHH Maulwurf pumps are high pressure centrifugal gas circulators especially designed for application in the chemical industry to increase the pressure of the nitrogen-hydrogen mixture in ammonia synthesis.

COMPRESSORS
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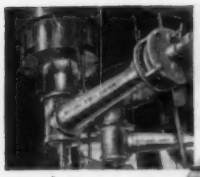
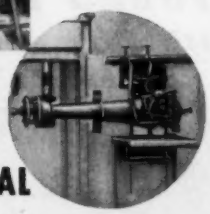


VERTICAL



OR

HORIZONTAL

many more hours on stream without forced shutdown with NATIONAL AIROIL

OIL-GAS TANDEM COMBUSTION UNITS

Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular horizontal Tandem Units . . . **plus:** special, precast refractory shapes for easier, cost-saving vertical installation and maintenance; secondary air inlet louvres for positive control of vertical flame pattern; and, all steel duplex detaching gear which enables swift, simple vertical burner changeover.

VERTICAL and HORIZONTAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with a minimum of excess air. NATIONAL AIROIL's patented Tandem Combustion Units allow secondary air to be easily and accurately controlled. By adjusting air control louvres, flame can be shaped to radiate heat uniformly without tube impingement.

The VERTICAL or HORIZONTAL Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame temperature using either fuel oil or gas. With the TANDEM UNIT's clean flame, a cold furnace can be brought to full capacity in a short time.

"Many, many more hours on stream, without shutdown" . . . yes, YOU will realize higher profits from YOUR heaters when NATIONAL AIROIL VERTICAL or HORIZONTAL Tandem Units are specified. Our new Bulletin 498 is yours for the asking.

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

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INDUSTRIAL OIL BURNERS, GAS BURNERS, AND FURNACE EQUIPMENT

Suppliers . . .

will see at first hand the applications for Chiksan products in Latin American oil fields, refineries, docks, and industrial plants.

ORBIT VALVE CO.'S sales in the field of industrial applications has created one promotion and the addition of several new representatives within the past 3 months.

Charles J. Folger who has been regional manager for Orbit over the Mid-Continent and Eastern States area has been promoted to manager of industrial sales. Folger takes over his new duties immediately and will headquarter in Tulsa.

Ebers

Parsekian

UNITED STATES RUBBER CO. has announced two changes in the executive staff of its Naugatuck Chemical division. **Earle S. Ebers**, formerly general sales manager, has been appointed assistant general manager of the division. **Harold M. Parsekian**, who was assistant general sales manager, has been named general sales manager.

Ebers joined the company in 1937 as a research chemist in its general laboratories. In 1946 he became plastic development manager for the chemical division. He was named sales manager for Kralastic and Vibrin resins in 1949, and four years later was appointed director of research and development for the division. In 1955 he was named general sales manager.

A natve of Canada, Ebers received his B.S. degree in chemistry from Dalahousie University at Halifax and his Ph.D. degree in chemistry from Harvard University.

Parsekian joined the company in 1949 when it purchased the chemical division of Glenn L. Martin Co., where he was director of sales and technical service. His first post was manager of Marvinol resin sales. He became manager of plastics sales in 1953, and the following year was appointed assistant general sales manager.

A native of Springfield, Mass. he obtained a B.S. degree in chemical engineering from Cooper Union Institute.

CONOFLOW CORP. has appointed **Brown & Morrison**, Charlotte, N. C., agents for ConoControls in the states of North and South Carolina.

Brown & Morrison has been a manufacturers' representative in the instrument and controls field for a number of years. Partners in the organization are: **W. C. "Bill" Morrison, Harold K. Couch,** and **Donald H. Jones.** All are well known in the area.

JEFFERSON CHEMICAL CO. has announced that two research chemists in the company's Austin Laboratories have reecntly been

G-B SNAP-ON DISTRIBUTORS

(See ad on facing page)

ALBUQUERQUE, Mt. States Insulation Co.
AMARILLO, Ball Distributing & Engr. Co.
APPLETON, J. D. Wilson Co.
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BILLINGS, Mont., Big Horn Supply, Inc.
BIRMINGHAM, Ala., Shook & Fletcher Supply
Southern States Iron Roofing Co.
BROOKLINE, Mass., Homans-Kohler, Inc.
BUFFALO, Frontier Insulation & Supply Co.
CHARLESTON, W. Va., Baldwin Asbestos Products Co.
CHARLESTON HEIGHTS, S. C., Stafford Insulation Co.
CHARLOTTE, N. C., Guy M. Beaty & Co.
CHATTANOOGA, Guy M. Beaty & Co.
CHICAGO, E. C. Carlson Co.
CINCINNATI, R. E. Kramig & Co.
CLEVELAND, The Miles Materials Co.
COLUMBIA, S. C., Southern States Iron Roofing Co.
COLUMBUS, Santeler Brothers
DALLAS, Insulation Supply Co., Inc.
DAVENPORT, Republic Electric Co.
DENVER, Gene Wright Lumber Co.
DETROIT, Coon-DeVisser Co.
EL PASO, Insulation & Specialties Co.
FARGO, N. D., Smith, Inc.
FT. SMITH, Ark., Gunn Distributing Co.
FT. WAYNE, Ind., M. H. Hilt, Inc.
FT. WORTH, The Bracken Co.
GREENSBORO, N. C., Starr Davis Co., Inc.
GULFPORT, Miss., Paine Supply Co.
HOUSTON, Precision Insulation Co.
INDIANAPOLIS, Central Supply Co.
IRON MOUNTAIN, Mich., Champion, Inc.
JACKSON, Miss., Paine Refrigeration Supply Co.
JOPLIN, Mo., Joplin Cement Co.
KANSAS CITY, Kelley Asbestos Co.
LITTLE ROCK, Gunn Distributing Co.
LOS ANGELES, Western Fibrous Glass Products
Thorpe Insulation Co.
LOUISVILLE, General Insulation & Roofing Co.
MADISON, Wis., J. D. Wilson Co.
MEMPHIS, John A. Denie's Sons Co.
MIAMI, Southern States Iron Roofing Co.
MILWAUKEE, J. D. Wilson Co.
MINNEAPOLIS, Asbestos Products, Inc.
MOBILE, Ala., Shook & Fletcher
NASHVILLE, Southern States Iron Roofing Co.
NEWARK, N. J., Eastern Steam Specialty Co.
NEW HAVEN, Conn., Insulation Supply Co.
NEW ORLEANS, Eagle Asbestos & Packing
NEW YORK, Eastern Steam Specialty Co.
OKLAHOMA CITY, Ball Distributing & Engineering Co.
OMAHA, Cardinal Supply & Mfg. Co.
PHILADELPHIA, John F. Scanlan, Inc.
PITTSBURGH, Dravo Corp.
PHOENIX, Ariz., Kircher Asbestos & Rubber Co.
RALEIGH, N. C., Southern States Iron Roofing Co.
RICHMOND, Va., Southern States Iron Roofing Co.
ROCKFORD, Ill., Mott Brothers Co.
SALT LAKE CITY, Bullough Asbestos Supply Co.
SAN ANTONIO, The Bracken Co.
SAN DIEGO, Western Fibrous Glass Products
SAN FRANCISCO, Western Fibrous Glass Products
SAVANNAH, Ga., Southern States Iron Roofing Co.
SEATTLE, Western Fibrous Glass Products
ST. LOUIS, A. G. Brauer Supply Co.
ST. PAUL, Asbestos Products, Inc.
SYRACUSE, N. Y., Industrial Supply Co.
TAMPA, Fla., Eagle Roofing & Art Metal Works, Inc.
TALLAHASSEE, Fla., Capital Refrigeration & Supply
TULSA, Okla., Ball Distributing & Engr. Co.
TUPELO, Miss., Paine Supply Co.
WASHINGTON, Walter E. Campbell Co., Inc.
WICHITA, Jamar-Olmen Construction Co.
VANCOUVER, B. C., Fleck Brothers Limited

GUSTIN gb BACON

*Big fitting . . . little space— but it's a snap with SNAP*ON!*

With a knife and sections of Snap*On, you can make big fittings quicker than you can say "one-piece pipe insulation molded of fine glass fibers". It is easy to see that you can save time and effort with these unique flexible fitting sections that just snap on the pipe . . . even in tight places. Other reasons why you will prefer Snap*On for hot or cold piping:

Highest thermal efficiency of any insulation for cold or hot piping up to 350°.

Lowest applied cost — just open the seam and it snaps on the pipe.

Lighter and cleaner to work with . . . won't break . . . permanent.

Snap*On is available in one-piece sections . . . in sizes up to 33" . . . plain or with a complete range of factory-applied jackets for appearance, vapor barrier or weatherproofing. It is stocked by a nation-wide network of G-B distributors. See adjoining column for name of your local distributor or write for complete information.

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GUSTIN-BACON

Manufacturing Company GUSTIN gb BACON

Thermal and acoustical insulations • Molded glass fiber pipe insulation
Pipe couplings and fittings

242 W. 10th St., Kansas City, Mo.

See Adjoining Column for Local Snap-On Distributor

For more data on advertised products, use Readers' Service Cards, last page.

DURABLA contains more high-grade asbestos than any other gasket material

Durabla Asbestos Sheet Packing, produced and marketed for almost 50 years, can be used with proved safety wherever gaskets are required. It is the one gasket material suitable for the widest range of temperature-pressure combinations.

More than 80% of Durabla Sheet is top quality selected asbestos fibre; the remainder is a special compound. Every square inch of sheet has uniform density, thickness and asbestos distribution. It is used for sealing water, steam, all oils, gases, alkalies, acids, refrigerants and hydrocarbons. Comes in eight commercial gauges.

Durabla gaskets, cut from Durabla asbestos sheet, do not leak or show any signs of creeping or distress at 1650 psi steam pressure—850° F. Gaskets come in all sizes and shapes.

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DM-20

Suppliers . . .

granted patents. U. S. Patent 2,766,258 has been granted to **Dr. J. D. Malkemus,** Austin, Texas. This patent is directed to a process of recovering an alkylene carbonate, e.g., ethylene carbonate, from a reaction mixture.

U. S. Patent 2,777,846 has been granted to **Dr. G. J. Laemmle,** Austin, Texas. It is a patent directed to a process for preparing morpholine from diethanolamine using 10-60 percent oleum to bring about the reaction.

E. I. DU PONT DE NEMOURS AND CO., INC., has appointed **W. Samuel Carpenter, 3rd,** director of sales of Du Pont's Petroleum Chemicals division succeeding **David H. Conklin,** who becomes managing director of the Du Pont Co. (United Kingdom) Ltd.

Carpenter

Other personnel changes in the Petroleum Chemicals division resulting from the promotions are:

Alfred R. Mullis, Eastern regional manager, will replace Carpenter as assistant drector of sales.

Earl G. Bennett, now manager of the Central region, will become the new Eastern regional manager.

Donald W. Frison, manager of the Mid-Continent region, will move into the Central region post vacated by Bennett.

Charles D. Towery, manager of the Gulf Coast region, will take over the management of the Mid-Continent region in addition to his present position.

R. Carter W. Jones, sales promotion manager of the Petroleum Chemicals division, has been named to the new position of sales service manager. He will be responsible for the operations, sales promotion, export sales, office, and general sales sections.

Harold C. Thompson, who is now assistant sales promotion manager, will succeed Jones as sales promotion manager.

Carpenter, a chemical engineering graduate from Princeton University, joined the Du Pont Co.'s Engineering department in 1938. In 1944 he was assigned to construction operations at Hanford, Washington, where the government's atomic energy project was built.

Returning to Wilmington in 1945, he entered the Construction division. The following year he became manager of that department's Planning division and later manager of its Industrial Engineering division. In 1947 he became assistant to the director of production of the Rayon division, and in 1949 became assistant manager of rayon yarn sales. In August of 1950 he was made assistant manager of the Rayon department's Planning division. He was director of manufacturing for the Cellulosics division before being named assistant director of sales for the Petroleum Chemicals division in 1955.

THE BABCOCK & WILCOX COMPANY'S Atomic Energy division head, **Marcel A. Cordovi,** was named recipient of the second annual Industrial Achievement award of the New York Chapter of the American

a better Foundry service for you . . .

SERVICE FOUNDRY

A DIVISION OF AVONDALE MARINE WAYS, INC.

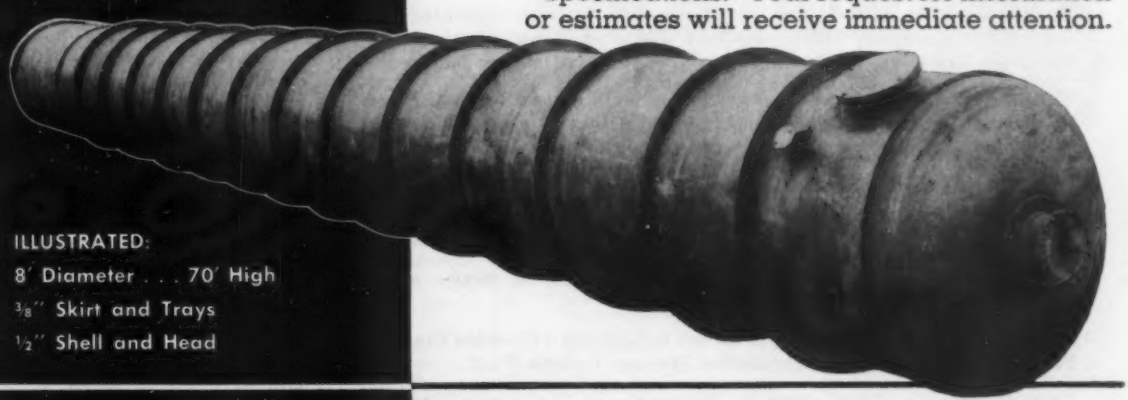
Foundries have come a long way since the forge and bellows . . . today they are mechanized and specialized, offering a wide variety of products and services including engineering and design. This is certainly true of SERVICE FOUNDRY, a division of Avondale Marine Ways, Inc. In addition to a complete foundry and machine shop service, there is a large and competent staff of engineers, draftsmen, and pattern makers highly skilled in meeting the requirements of your industry. Among recent improvements, a new electric furnace has just been installed—the most modern of its kind. For an all-around better *foundry service . . . see Avondale!*

SERVICE FOUNDRY a division of Avondale Marine Ways, Inc.

416 Erato St. New Orleans, La. CAnal 3836

POSEY FRACTIONATING TOWERS

Posey's experience in producing welded steel plate structures dates back to 1910 . . . so Posey has the experience as well as the facilities to design and fabricate almost any type of structure required by your industry. Trust Posey to build to your most rigid specifications. Your request for information or estimates will receive immediate attention.



ILLUSTRATED:
8′ Diameter . . . 70′ High
3/8″ Skirt and Trays
1/2″ Shell and Head

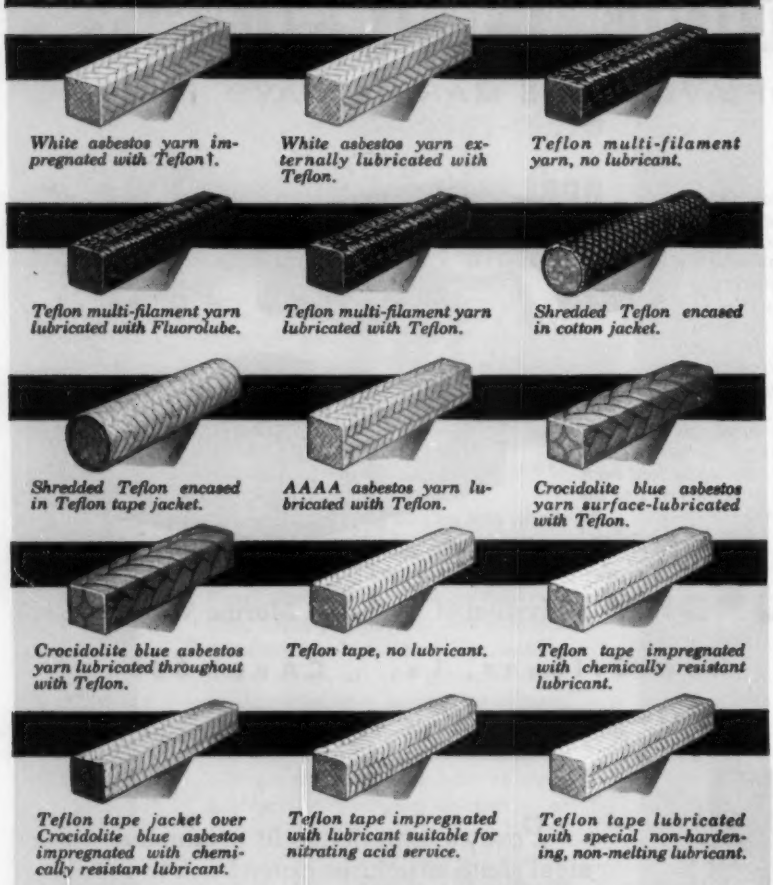
TANKS • PRESSURE VESSELS
STEEL PLATE FABRICATION
STACKS • DIGESTERS
DREDGE PIPE AND ACCESSORIES

POSEY IRON WORKS, INC.

Steel Plate Division Lancaster, Penna.
New York Office: Graybar Building

For more data on advertised products, use Readers' Service Cards, last page.

15 SPECIFIC PACKINGS FOR ALL CORROSIVE SERVICES



White asbestos yarn impregnated with Teflon†.

White asbestos yarn externally lubricated with Teflon.

Teflon multi-filament yarn, no lubricant.

Teflon multi-filament yarn lubricated with Fluorolube.

Teflon multi-filament yarn lubricated with Teflon.

Shredded Teflon encased in cotton jacket.

Shredded Teflon encased in Teflon tape jacket.

AAAA asbestos yarn lubricated with Teflon.

Crocidolite blue asbestos yarn surface-lubricated with Teflon.

Crocidolite blue asbestos yarn lubricated throughout with Teflon.

Teflon tape, no lubricant.

Teflon tape impregnated with chemically resistant lubricant.

Teflon tape jacket over Crocidolite blue asbestos impregnated with chemically resistant lubricant.

Teflon tape impregnated with lubricant suitable for nitrating acid service.

Teflon tape lubricated with special non-hardening, non-melting lubricant.

John Crane CHEMLON *BRAIDED PACKINGS

Specific service conditions are always best handled with a packing designed for the purpose. This is especially true when it comes to the hard-to-handle liquids in the chemical, petrochemical and refinery industries.

For this reason John Crane has developed 15 individual field-proved types of Chemlon Braided Packings. Within this line there is a type and style that will meet any combination of service conditions and requirements.

1. All known industrial acids, alkalis or solvents.
2. Temperatures from −120°F to +600°F.
3. High or low shaft speeds, also valve stems.
4. Longer packing life due to lower coefficient of friction and non-raveling construction.

Send in your service condition and we will recommend a Chemlon Braided Packing best suited to your application. Request Bulletin P-325.

Crane Packing Co., 6420 Oakton St., Morton Grove, Ill. (Chicago Suburb).
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

†T. M. for DuPont Teflon **T. M. for the Best in DuPont Teflon*

CRANE PACKING COMPANY

Suppliers . . .

Society of Metals. The award was presented to Cordovi at the Society's annual dinner held at the Hotel Victoria.

Commenting upon the award, Charles M. Parker, chairman of the Award Committee, lauded Cordovi on his "brilliant achievements in the field of metallurgy. Many have had longer tenures in the profession than our recipient, but it is a rarity to find so young an individual who has attained so much in a scientific field."

Cordovi was born in Sofia, Bulgaria, on Nov. 17, 1915, and received his A.B. degree in general sciences and arts from the American College at Sofia in 1935. He holds B.M.E., M.M.E. and M.E. degrees from the Polytechnic Institute of Brooklyn, and has studied metallurgical and mechanical engineering at the University of Michigan and the University of Pittsburgh. He is presently adjunct professor of metallurgical engineering at the Institute.

ROBERTSHAW-FULTON CONTROLS CO. has announced the appointment of **A. W. Roat** as applications engineer, controls sales section. Roat formerly served on the sales staff of the company's Fielden Instrument division. Prior to that he was in instrumentation sales with another controls manufacturer. He is a member of the Instrument Society of America.

Roat

Roat's office will be at the Fulton Sylphon division, Knoxville, Tenn.

AMERICAN METER CO. has named **Bynum C. Jacobsen** sales engineer in the Chicago sales district and **Clifford E. Saylor,** engineer in the Telemetering department at the company's Erie, Pa. plant.

Jacobsen is a recent graduate of the University of Oklahoma where he received his degree in natural gas engineering. He served with the U. S. Marine paratroops during World War II.

Saylor was formerly self employed in Johnstown, Pa. as a heating and air conditioning engineer for 10 years. He attended William & Mary College and Virginia Polytechnic Institute. During World War II, he served with the U. S. Navy.

Sorensen & Company, Inc., Stamford, Conn., has announced the appointment of **Pinkney & Hine** as its representative in North Dakota, South Dakota, Minnesota and Western Wisconsin. Pinkney & Hine is located at 1925 Nicollet Avenue, Minneapolis 3, Minn.

Jones & Laughlin Supply Division assembled 33 key field officials at the firm's general headquarters office in Tulsa, for the fourth annual sales management conference. Attending the three-day conclave from nine states and two Canadian provinces were district sales managers, assistant district sales managers and sales office managers.

Principal speakers for the opening day series of lectures and discussions included:

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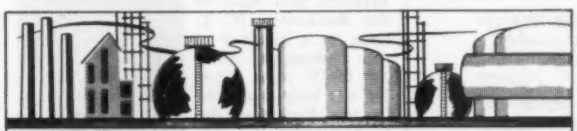

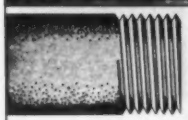

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MOLYKOTE® Type G Lubricant Offers Nearly 100% Safety Against Galling and Seizing

The annual cost of repairs due to galling and seizing of high temperature threaded connections runs into fantastic figures. One oil refinery estimates a yearly expenditure of $60,000 due to this cause. Many of the top refineries are presently using MOLYKOTE, Type G, to practically eliminate these problems.

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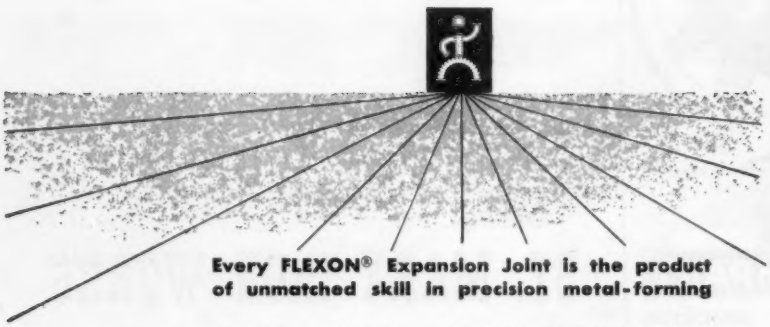

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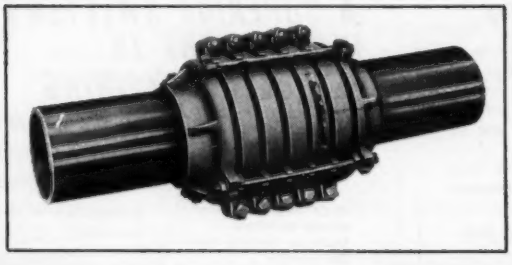
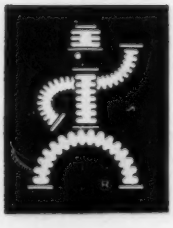


EJ-200



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Suppliers . . .

Rainey Elliott, president; **W. L. Wolfe,** vice president—sales; **R. J. Woods, Jr.,** director of sales; **H. H. Wilson,** director, Gulf Coast operations, Houston; **A. G. Bastian,** manager—field sales division; **J. T. Batchelor,** sales manager, tubular products; **W. O. Hardy,** sales manager, general products sales; **C. E. Bogle,** manager—wire rope sales; **W. R. Clarke,** manager—production equipment sales; **Jack Judd,** manager—drilling equipment sales; and **J. A. Tucker,** chief sales engineer—projects.

During the closing session which was preceded by office visitations, the group heard talks delivered by guest speakers **E. A. Booth,** manager—tubular products, and **Dr. Bernard Hanes,** consulting psychologist, Cuyahoga Falls, Ohio.

Mitchell

Kohart

AMERICAN METER CO., Philadelphia, has named **Roy C. Mitchell, Donald E. Kohart** and **John Q. Vreeland** sales representatives. Mitchell will work in the Rochester, N. Y. area, as a member of the company's Albany, N. Y. sales force. He has been employed in the Personnel department for the past five years.

Vreeland

Kohart has been assigned to the Boston sales district. He was formerly associated with Hooper-Holmes, Inc., N. Y. for three years and is a graduate of Adelphi College.

Vreeland will work in the company's Wynnewood, Pa. sales district. He was formerly associated with the New York Telephone Co. and attended Northwestern University while serving with the U. S. Navy during World War II.

Visco Products Co., Inc., a unit of National Aluminate Corp., has announced plans for the construction of a new million dollar plant to produce oil industry chemicals. The new facility will be located at Sugar Land, Texas, adjacent to Visco's plant No. 1. Construction will begin as soon as practicable and the tentative schedule calls for completion about Jan. 1, 1958. Manufacturing operations in the new plant will be as automatic as possible to assure best quality control and high production capacity at lowest unit cost. Some older portions of the present plant will be converted to warehouse area when the new facility is in operation.

Crude oil emulsion breakers, refinery desalting chemicals and oil production

Griscom-Russell is now entering the last decade of a

Century of Progress

Looking Backward

Ninety years ago in New York Harbor a modest ship chandlery was established to service the needs of seagoing vessels as they plied into port for fitting and repairs. The enterprise developed fast until it was manufacturing small equipment and later a line of coil tube heat exchangers, which due to their long, efficient and trouble free service, created the reputation for dependable products which The Griscom-Russell Company still enjoys. There followed equally reliable lines of Marine Distilling Plants, Tubular Exchangers, Bentube Evaporators, Feedwater Heaters and Extended Surface Heat Exchangers for land and sea service. Through the years the chemical, petroleum, utility and marine industries have recognized the increasing need for heat exchange equipment and G-R has met these needs with progressive designs and manufacturing facilities. The requirements for increasingly higher temperatures and pressures have been met by G-R's 200 engineers, designers, draftsmen and by a well qualified manufacturing personnel. Today we serve a long line of established customers in all major industries.

Looking Forward

We are now on the threshold of the atomic age, a challenge to the engineering, designing and manufacturing ingenuity of our people. Nuclear power will necessarily supplant present day power supply systems as our resources of oil and coal are depleted. G-R has been engaged in research resulting in the production of heat transfer equipment for this field. Such equipment must operate under service conditions involving fluids at temperatures and pressures in the high ranges. Severe service conditions are also met with in the petro-chemical field, an industry which is still in its infancy. In the manufacture of heat transfer equipment of this kind the most exacting manufacturing techniques must be employed. G-R has the necessary facilities including X-ray and stress relieving, ultrasonic and dye penetrant testing, welding equipment and techniques requiring specially qualified and registered operators. The indications are that the heat transfer equipment of the future will demand that these manufacturing practices become routine procedures. As in the past, G-R is prepared. To those who have new problems involving heat transfer between any fluid mediums including liquid metals, G-R engineers are able to advise. It is probable that they have already met similar situations.

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G-R **fin-fan** installations have amply proven the ruggedness, operating economy and dependability of the design and construction of these units. They are available to serve a wide range of cooling and condensing duties; each G-R Exchanger is designed and custom-built for its specific service; and the performance of each unit is fully guaranteed.

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GR2400

Suppliers . . .

anti-corrosion chemicals, Visco's three principal product lines, will all be manufactured in the new plant. The company will continue to produce oxyalkylation products and certain specialized chemicals in the existing plant. Visco also operates at plant at Anaheim, Calif., where it produces oil industry chemicals. The company's general offices are located in Houston, Texas.

DIAMOND ALKALI CO., Cleveland, has promoted **Jack E. Davis** to special staff assistant in the Sales department. Davis comes to his new position following nearly eleven years experience as a member of the company's Philadelphia branch sales staff. He joined the Diamond organization in September, 1939 as a sales clerk in Pittsburgh and was transferred to Painesville the following year.

A native of Pennsylvania, born in Swissvale, he graduated in 1938 from the University of Pittsburgh with a B.S. degree in business administration. Davis is a World War II veteran, having served in the Army 171st Combat Engineers Battalion, from 1943 to 1946, when he returned to Diamond. Since then, as a member of the Philadelphia sales staff, he has represented the company in the Eastern Pennsylvania area.

WALWORTH CO. has appointed **George E. McDonald** vice president and treasurer. A graduate of Grinnell College, McDonald joined Walworth as an accountant in 1925. He was named general auditor in 1938 and treasurer in 1953.

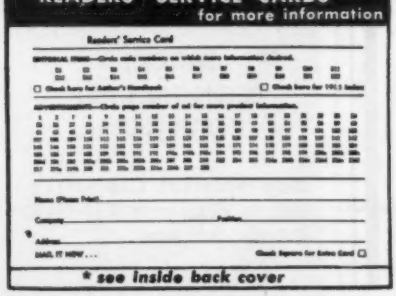
E. I. DU PONT DE NEMOURS AND CO., INC. has promoted **David H. Conklin** from director of sales of the Chemicals division to managing director of the Du Pont Co. (United Kingdom) Ltd.

Conklin joined Du Pont in 1947 and shortly afterward became West Coast district manager for the Petroleum Chemicals division, with headquarters in Los Angeles, Calif. Two years later, he was transferred to Wilmington, Del., as assistant sales manager of the division. In 1951, he was named assistant director of sales and on May 8, 1953, was made director of sales.

Prior to joining Du Pont, Conklin worked for Ingersoll-Rand, handling sales, service, and installation of industrial and oil field equipment at the company's Los Angeles office.

Goodyear Tire & Rubber Co. has announced the retirement of **Joseph E. Mayl,** vice president, general products group. **Sam DuPree,** general manager of Good-

use these
READERS' SERVICE CARDS*
for more information



* see inside back cover

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HEAT RESISTANT
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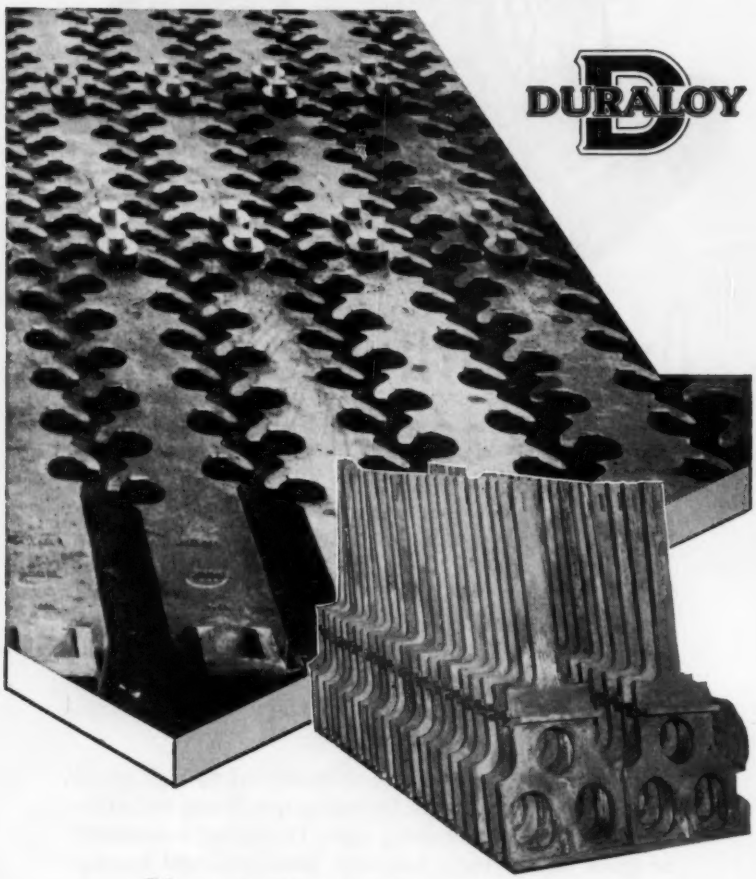

You can't buy Better Tube Supports . . . DURALOY Tube Supports are alloyed to meet individual corrosion and heat requirements. They are alloyed by experienced metallurgists and melted and cast by experienced high-alloy foundrymen, both groups with experience going back some thirty years. Castings are carefully tested in our own laboratories which are completely equipped for metallurgical, chemical and physical testing.

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Suppliers . . .

year's Industrial Products division, will succeed Mayl. **R. B. Warren**, former sales manager, Industrial Products, has been appointed to the post to be vacated by DuPree.

Mayl joined Goodyear in 1924, as assistant manager of its truck tire department. A year later, he was appointed manager of the truck and bus department and then, in 1929, was made manager of the company's Southern division.

In 1937, he was sent to the West Coast as vice president of Goodyear-California, remaining there until 1944, when he returned to Akron as vice president and sales manager of Goodyear's Tire Sales division. With formation of the company's Films, Foam and Flooring division in 1952, he was appointed vice president of that new sales group. In April, 1956, Mayl was named subsidiary vice president to coordinate activities of the company's general product divisions.

Born in Dayton, Ohio, Mayl graduated from the University of Dayton in 1906 with a B.S. degree.

Flori-Houston Pipe & Steel has appointed **Roy W. Reierson** vice president and general manager of the Houston plant. Reierson will make his headquarters in Houston while the general offices of the combination will be at the Flori office in St. Louis. Reierson has been with Houston Pipe & Steel since 1943.

THE PERKIN-ELMER CORPORATION has purchased from Kaye Development Co., a majority-owned subsidiary of Baird-Atomic Instruments, Inc., the rights, development and inventory of the Spectrostat and Trichrometer process analyzers. Morton Kaye, founder of the company, has also joined Perkin-Elmer as a member of its Instrument division engineering department.

MINE SAFETY APPLIANCES CO., producer of safety equipment, has established a wholly-owned subsidiary in Venezuela.

The new firm, **Mine Safety Appliance de Venezuela C. A.**, will handle all sales and service in Venezuela, with Walco S. A.,

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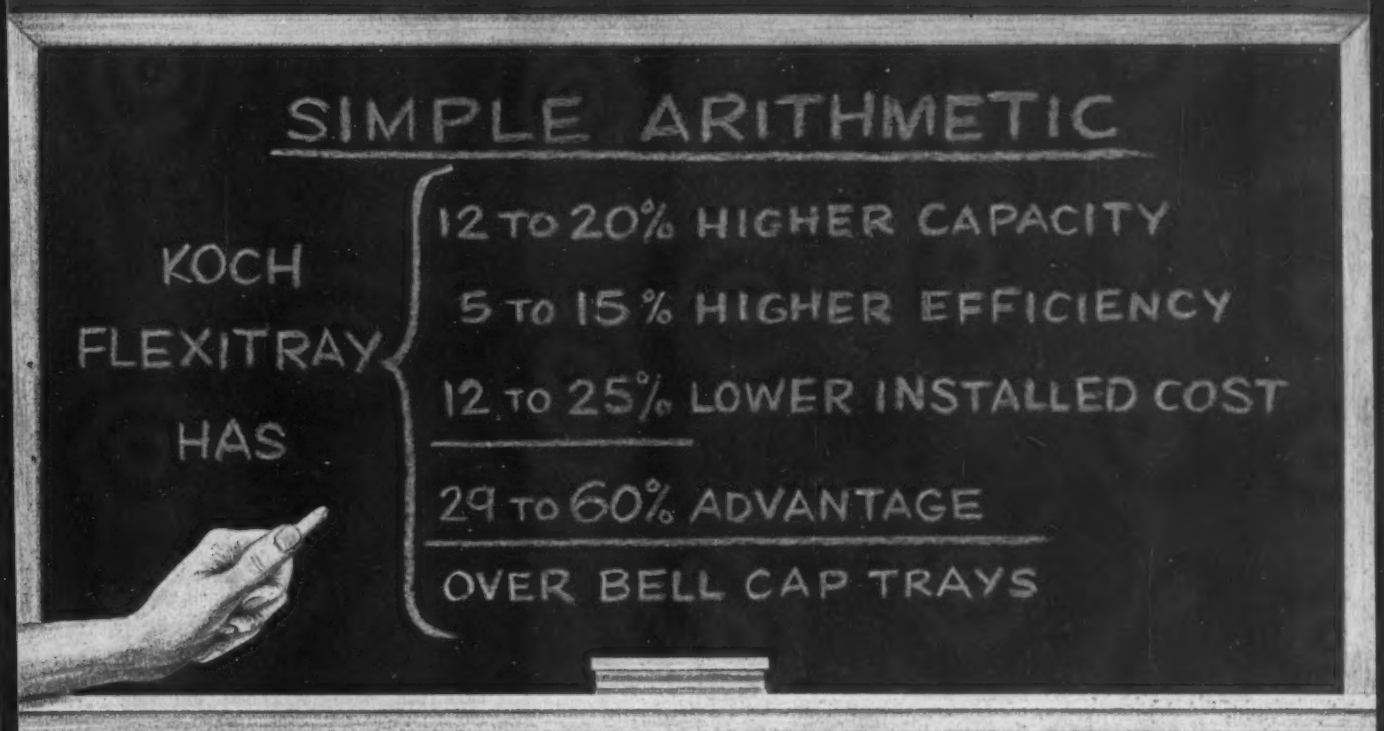
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KOCH FLEXITRAY HAS
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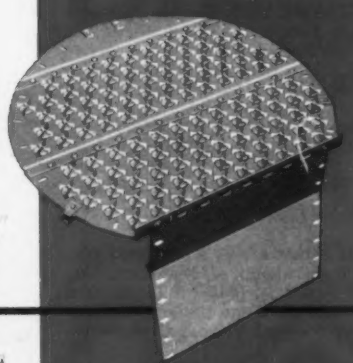

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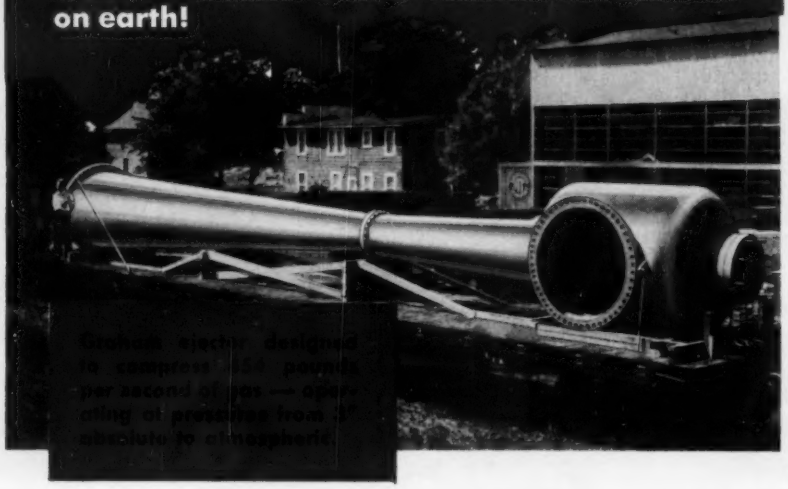
. . . or more properly, we might say . . . the biggest vacuum pump (thermo-compressor) on earth!



If your vacuum problem requires a steam or gas operated ejector, capable of sustaining accurately predicted absolute pressures throughout a given range — then come to Graham.

This corporation operates one of the largest and best equipped test laboratories engaged in this class of work.

Actual runs — and in the real larger sizes comparable pilot models — prove out our predictions. Graham does not oblige the user to take the risk.

We are vacuum specialists and are equipped to quickly deliver to you *any type of ejector*, from the smallest single stage unit — selling for just a few dollars — up to the most involved and modern type, produced for industry's more complicated requirements.

Send us your inquiry. A conference with our engineers in no way obligates you.

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Suppliers . . .

also a Venezuelan corporation, as sales agent.

C. M. Donahue, vice president of the parent corporation and head of the International division, will be president of the Venezuelan firm. **J. T. Ryan, Jr.,** president of MSA, will be a vice president of the subsidiary. Another vice president will be **G. H. Deike, Jr.,** with **C. P. Rooney** as secretary.

OAKITE PRODUCTS CO. has announced that **Charles F. Radley,** one of the original directors, has retired from active duty as director of publicity and member of the company's board of directors. He is, however, continuing in the employ of the company as a consultant on advertising, public relations, and general management policy.

Radley

Employed in 1917 as editor of *Oakite News Service,* the firm's external publication, Radley was elected to the board of directors in 1926 when that company was organized as successor to the original Oakley Chemical Co. He was appointed director of publicity in 1927. For the past thirty years he has been responsible for Oakite's industrial advertising program.

FRICK CO. has promoted **John H. Carter** to manager of the St. Louis branch office. Carter is a member and former president of the St. Louis chapter of A.S.H.A.E., and has also been active in the joint Council of the Associated Engineering Societies of St. Louis, and the Missouri and National Societies of Professional Engineers.

Carter was with Frick Company and later with their St. Louis distributor, Kremer-Hicks Co., from 1934 until he entered the Navy in 1942. Since 1945 he has been a consulting engineer specializing in refrigeration and air conditioning, and has also been a project engineer with Sverdrup & Parcel, Inc.

THE GIRDLER CO. has added **W. Doss Lumkin** to its catalyst department. He will specialize in the marketing of catalysts employed in the processing of fats and oils, and in the hydrosulfurization and treating of petroleum feed stocks.

Lumpkin began his business career with the Phillips Petroleum Co. and was in charge of the Phillips control laboratory at Okmulgee, Okla. Later he became associated with the Filtrol Corp., Los Angeles, and was in charge of the company's fats and oils field development and sales programs. He joined the Girdler's Votator division in 1954 and was assigned to the sale of catalysts used in the fatty oils industry.

SOUTHWEST FABRICATING & WELDING CO., Houston, a subsidiary of Walworth Co., has elected **Ardon B. Judd** president. **Fred W. Belz,** president of the parent company, becomes chairman of the board of Southwest.

Judd joined Southwest in 1951 and be-

For more data on advertised products, use Readers' Service Cards, last page.

Loosens FROZEN PARTS FAST!

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Won't
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Shoots
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Same formula as famous Kroil that has pleased 14,000 industrial users for 10 years or more.

Loosens stuck together metal parts, bushings, bearings, bolts, screws, pipe, etc., "anything from an embalmer's needle to a bulldozer," one customer said.

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AMERICAN PETROLEUM REFINING By H. S. Bell	8.00

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COMPANY_____

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For more data on advertised products, use Readers' Service Cards, last page.

Assures control of paraffin viscosity

EPOLENE "N"

Viscosity control of paraffin formulations calling for the addition of polyethylene is assured—if Epolene "N", Eastman polyethylene wax, is used. Because uniformity of coating paraffins is so important, Eastman takes special care to produce Epolene between narrow limits of viscosity.

Published specifications for the viscosity of Epolene "N" are within the range of 2200 and 2700 cps at 125° C—your assurance of close control and uniformity from batch to batch.

The table shows what this uniformity means in polyethylene-based paraffin formulations. Five percent samples of Epolene "N", from the *extremes* of our production range, were mixed with paraffin—and the viscosities of the resulting mixtures were taken on the same Brookfield Viscometer.

Sample	Viscosity at 200° F (cps)
100% paraffin	4.8
95% paraffin—5% Epolene "N" (2250 cps)	7.5
95% paraffin—5% Epolene "N" (2700 cps)	7.6

Although viscosity varies from paraffin to paraffin, these results dramatize the advantage of using Epolene "N". Thus, for the paraffin under test, the maximum variation encountered in the final viscosity of the 5% Epolene blend was only 0.1 centipoise.

To assist manufacturers in taking full advantages of the outstanding properties of Epolene "N", Eastman maintains an extensive technical service laboratory in Kingsport, Tennessee. Through this laboratory, paraffin formulators are offered expert assistance in formulations and manufacturing techniques.

For samples and further information, write Eastman Chemical Products, Inc., subsidiary of Eastman Kodak Company, Chemicals Division, Kingsport, Tennessee.

Epolene

EASTMAN POLYETHYLENE WAXES

SALES OFFICES: Eastman Chemical Products, Inc. Kingsport, Tennessee; New York City; Framingham Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston **West Coast: Wilson Meyer Co.,** San Francisco Los Angeles; Portland; Salt Lake City; Seattle

For more data on advertised products, use Readers' Service Cards, last page.

Suppliers . . .

came executive vice president and treasurer on Jan. 1, 1956, when Walworth acquired the company. He will continue to serve as treasurer.

A native of Nebraska, Judd attended Denison University and the University of Texas Law School. He served in World War I as adjutant of the 165 Field Artillery Brigade.

He was with the legal department of Cia. Transcontinental de Petrolcos, S. A. in Tampico, Mexico, until 1922 when he joined the Republic Supply Co., a subsidiary of Republic Steel.

ALLIED CHEMICAL & DYE CORP. has announced three change involving managerial assignments at the Detroit plant of Solvay Process Division. **James E. House**, manager since 1954, became assistant to the director of operations; **William J. Bobek** succeeded House as manager, and **Paul B. Cornell** was named assistant manager.

House, a native of Illinois, has been a Solvay employee since obtaining his degree in chemical engineering from the University of Michigan in 1934. Appointed Soda Ash supervisor at the Detroit plant in 1946, he became manufacturing superintendent in 1948. Two years later he was named assistant plant manager.

Since 1954, Bobeck has been assistant manager at Detroit. Prior to that he was supervisor of the Ammonia-Caustic Soda section and supervisor of Labor and Personnel. A graduate of Rensselaer Polytechnic Institute, he has been with Solvay since obtaining his chemical engineering degree in 1934.

A Univerity of Michigan graduate, Cornell is also a chemical engineer. He joined Solvay in 1950. Appointed assistant supervisor of the Soda Ash section in 1953, he became supervisor of that section two years later.

LACLEDE-CHRISTY CO. DIVISION, H. K. Porter Co., Inc. has appointed **Thomas F. Gallagher** district sales manager, Chicago. Gallagher, a sales engineer, for Laclede-Christy since 1946, previously was in Buffalo, N. Y. He graduated from Washington University, St. Louis, in 1939 with a B.S. degree in engineering administration. He was with General Steel Castings Corp., Granite City, Ill., from 1939 to 1942 as a sales engineer, and with the Army Ordnance department from 1942 to 1946.

He is a member of the American Ceramic Society and other professional groups.

ALLIED CHEMICAL & DYE CORP., Solvay Process division has appointed **Frederick Nill** assistant to the director of develop-

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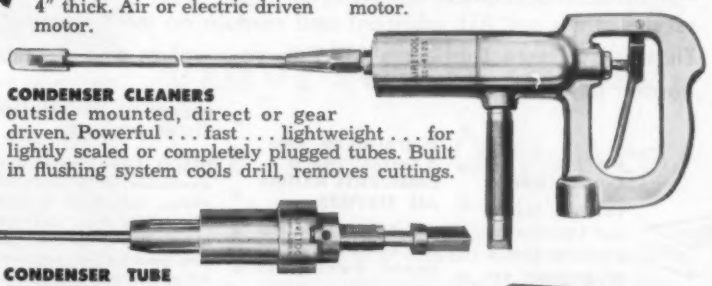
LESS "LOST TIME" with AIRETOOL

You'll keep plant production and efficiency way up . . . practically eliminate costly downtime due to tube failure, with AIRETOOL Condenser Tube Maintenance equipment. Even at "turn-a-round" time, lost stream time is kept to a minimum. Repair, removal and replacement of tubular equipment is accomplished faster, easier and at less cost, with AIRETOOL equipment on the job.

Don't wait . . . investigate all the advantages of AIRETOOL Condenser Tube Maintenance Equipment now. There's a precision built AIRETOOL tube maintenance tool for every type of tubular construction. See your nearest AIRETOOL Representative today . . . or write AIRETOOL MFG. CO., Springfield, Ohio, for information.

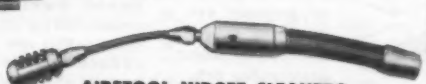
NEW INTERNAL TUBE CUTTER quickly removes damaged or leaky tubes. Cuts through steel or non-ferrous tube sheets to 4" thick. Air or electric driven motor.

NEW PUSH-TYPE INTERNAL TUBE CUTTER for non-ferrous tubes ⅝" to 1" O.D. cuts through tube sheets 1" to 4" thick. Operates on your own air or electric motor.



CONDENSER CLEANERS outside mounted, direct or gear driven. Powerful . . . fast . . . lightweight . . . for lightly scaled or completely plugged tubes. Built in flushing system cools drill, removes cuttings.

CONDENSER TUBE EXPANDERS parallel rolling, self-feeding, ball bearing thrust. Rolls tubes to uniform thickness, with maximum bonding.



AIRETOOL MIDGET CLEANERS for lightly scaled tubes. Small, powerful, excellent for cleaning small tubes with extremely short radii turns or hairpin bends.

Send for Bulletin #59, illustrating the complete new line of AIRETOOL Tube Cutters, cleaners, expanders, accessory and specialty tools.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.
REPRESENTATIVES: In principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands.
CANADIAN PLANT: Brantford, Ont.

Suppliers . . .

ment. Nill received his chemical engineering degree from Cornell University. He joined Solvay at Syracuse in 1919 as a chemist, then advancing to technical assistant and supervisor of the calcium chloride and soda ash sections.

In 1934 he was assigned to the Detroit plant as a supervisor and the following year became assistant manager at Baton Rouge. Nill returned to Syracuse in 1942. For the past six years, he has been assistant to the director of operations.

BAILEY METER CO. has named **James W. Taylor** manager of the company's Milwaukee district.

Bailey, whose headquarters are in Cleveland, manufactures industrial instruments and automatic controls for power and process industries.

Taylor, formerly acting manager, was graduated from Pennslyvania State University in 1950, with a degree in fuel technology. He joined Bailey Meter in 1953.

HARBISON-WALKER REFRACTORIES CO. has named **Charles D. Gabor** assistant chief engineer. He has been in the company's engineering department since 1941. Most recently he has been a project engineer.

Gabor is a mechanical engineering graduate of Carnegie Institute of Technology.

NATIONAL ALUMINATE CORP., has named **Dr. William P. Hettinger, Jr.,** research director for the Catalyst division. He was formerly director of the catalysis division at Sinclair Research Laboratories, Inc., where among his activities, he supervised exploration and development of catalysts and processes for petroleum refining.

A member of Sigma Xi and Phi Lambda Upsilon honorary fraternities, A.C.S., and the Catalysis Club of Chicago, Dr. Hettinger received his Ph.D. degree from Northwestern University in 1951.

ARMSTRONG CORK CO. has promoted **John J. Roper,** from sales representative for the Insulation division to assistant district manager of the division's Boston district office.

Roper joined Armstrong with an established background of 24 years in the heat insulation field, most of which was spent in the Boston area.

Active in the New England Asbestos Contractors Association, he is a past president of the organization and is currently a member of the association's executive committee. Roper graduated from Suffolk University in 1941, with a B.S. degree in law.

WOLVERINE TUBE, Division of Calumet & Hecla, Inc., has appointed **James C. Cameron** to fill the newly created post of manager of market research. Cameron brings to his new post an extensive and varied background in the field of market research and analysis. He was most recently with the management consultant firm of J. D. Woods and Gordon, Ltd., Toronto, Canada.

He will make his headquarters at Wolverine's General Sales offices in Detroit.

GRINDING MACHINE DIVISION of Norton Co. has won two top industrial safety awards. At ceremonies held in the Hotel Statler in Boston, **James M. Lawson,** general foreman and chairman of the division's plant safety committee, accepted the Massachusetts Safety Council's award for the best safety record in the heavy machinery group.

Norton safety engineer **Nelson P. Ingalls** has just been notified by the National Safety Council that this division has also earned the council's highest award, the Award of Honor. The division won both these awards last year.

THE BABCOCK & WILCOX CO.'s Tubular Products division has opened its Atlanta, Ga., district sales office. **William Lehr** has been appointed to manage the new office.

The office is serving the states of Georgia, South Carolina, North Carolina, Alabama, Florida and the southeastern section of Tennessee.

Before his move to Atlanta, Lehr had been district salesman for the B&W Tubular Products division in Cincinnati. He joined B&W in 1955 after prior association with Tube Turns-Girdler Co., in Louisville.

Lehr attended Centre College, in Danville, Ky., and the University of Louisville.

THE GIRDLER CO.'s Catalyst department, has announced the appointment of **O. R. Matzner** to the sales engineering staff. Girdler, which has its headquarters in Louisville, is a division of National Cylinder Gas Co.

Matzner was born in Fort Worth, Texas. He obtained his B.S. degree in chemical engineering at Texas A. & M., and his

DESCO LUBRICANTS STAY

in your plug valves – make plug valves stay on the job!

Plug valve lubrication is our business — *our only business!* DESCO Plug Valve Lubricants are synthetics made from chemical compounds specifically developed for each type of service. They are ALL lubricant and contain no inert material. That's why Desco Lubricants STAY in your valves and do not harden or coke-up.

HELPFUL COLOR CODE

The four Standard Lubricants are Color Coded to prevent errors and speed operation. Gun grip, valve tab, carton labels, and the lubricant itself are a matching color to identify the service.

4 STANDARD AND 3 SPECIAL DESCO LUBRICANTS HANDLE ALL SERVICES

The DESCO user has the advantage of never having to stock many lubricants — this not only reduces inventory but it also reduces the possibility of using the wrong lubricant. Most plants require only one or two types.

PACKED IN CONVENIENT STICKS OR BULK

DESCO Lubricants are available in 6 sizes of sticks, including a gun size stick. For volume users DESCO Lubricants are packed in 5-quart, 40-pound and 100-pound drums.

DELTA-DESCO

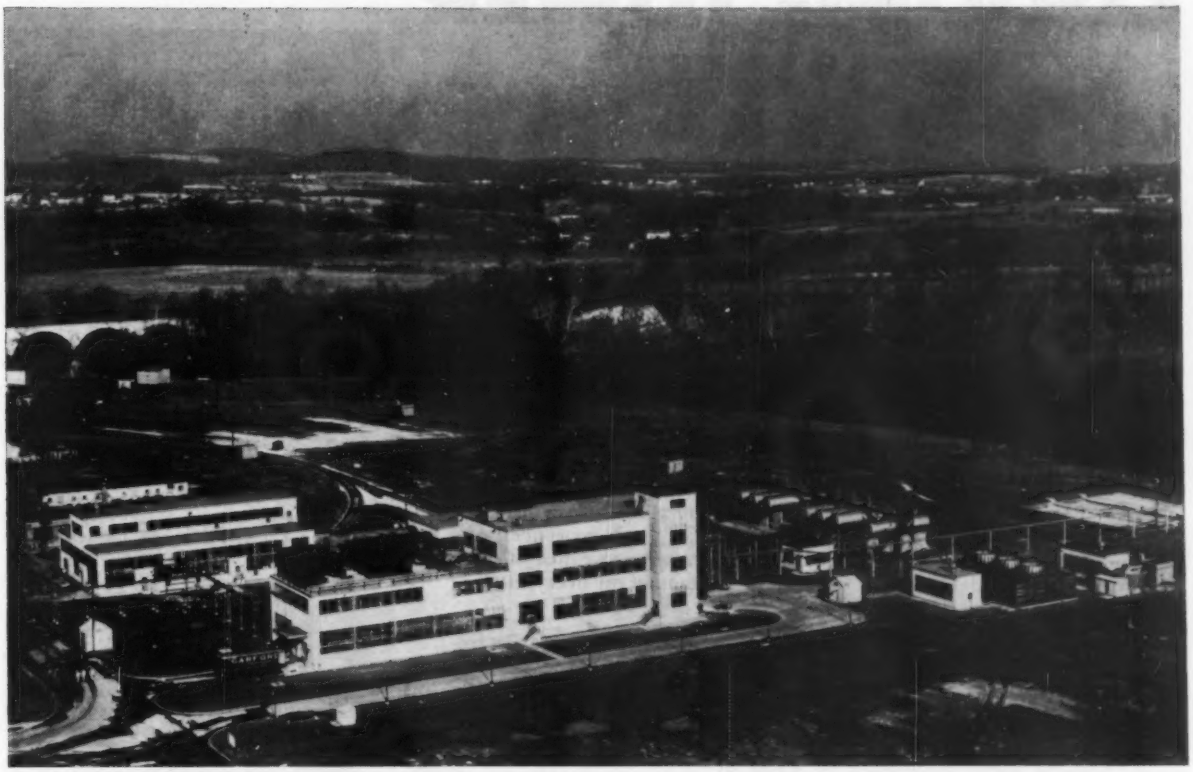
WRITE FOR CATALOG

The Only Complete Plug Valve Lubrication Company

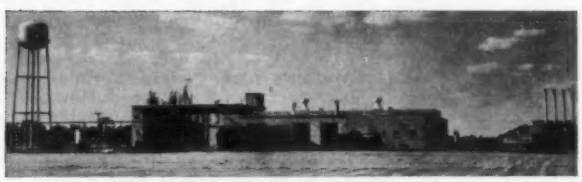
PLUG VALVE LUBRICANTS AND EQUIPMENT

Color Coded Lubricants • Hand Guns
Fittings • Air-Motor Volume Guns
Automatic Lubricators • Electronics

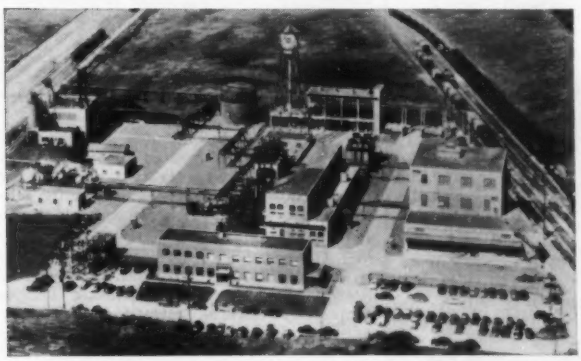
DELTA-DESCO COMPANIES
DELTA ENGINEERING SALES CO.
Box 1403 Shreveport, Louisiana
Branch Offices in All Principal Cities



Polyvinyl chloride resin plant of Firestone Tire & Rubber Co., designed and constructed by Blaw-Knox engineers



Polyvinyl acetate plant designed and built by Blaw-Knox for National Starch Products Inc.—later doubled in capacity by Blaw-Knox



Vinyl chloride monomer and polymer plant built for Glenn L. Martin Company and subsequently expanded for U. S. Rubber Company

Blaw-Knox has been building vinyl resin plants for over 10 years

Blaw-Knox is a pioneer in the design, engineering, and construction of complete plants for the resins and plastics industry. Included are new installations and expansion of existing facilities for both polymer and copolymer production. This extensive experience and accumulated technical "know-how" is available to you. We invite you to discuss your plans with our engineers.

BLAW-KNOX COMPANY

Chemical Plants Division • Pittsburgh 22, Pennsylvania • Chicago 1, Illinois

Birmingham • New York • Philadelphia • San Francisco • Washington, D.C.

Designers, engineers and builders of plants for production of Alkyd Resins • Amino Resins • Epon Resins • Oil Bodying • Phenol Resins • Silicone Resins • Synthetic Rubber • Vinyl Polymers and Copolymers • Polyesters

For more data on advertised products, use Readers' Service Cards, last page.

COOLING TOWER POWER GOES HIGH HAT

Putting the fan cylinder to work, making it a functional part of the tower, is Marley's latest achievement that brings a new look to industrial cooling towers. As an integral part of Marley tower power the new VL (vertically laminated) Fan Cylinder* has a job to do beyond merely discharging exhaust vapor at high elevation to minimize the hazard of fogging . . . IT AMPLIFIES FAN EFFICIENCY AND COOLING PERFORMANCE.

The distinctive VL contour is dictated by tested, scientific design that increases air volume by recovering velocity pressure . . . simply making more air do more cooling. To engineers specifying new equipment, this is an added and important assurance of Marley's ability to deliver full, testable performance on every cooling tower installation.

As modernization equipment for existing towers, VL fan cylinders positively reduce water cooling cost in any of three ways:

1. **Cooling a greater volume of water at specified temperatures without added fan horsepower.**
2. **Cooling specified volume of water at specified heat load to lower temperature without added fan horsepower.**
3. **Reducing required horsepower for any specified performance.**

VL fan cylinders are safe, sturdy units. Laminated construction provides a rugged design which assures long, trouble-free service. Bolted laminated bands and integral truss bracing result in a unitized packaged assembly independent of tower framework for structural stability. Safety to operating personnel is provided by the strength and height of the cylinder and by the large access door permissible only in VL design.

Founder Member—
Cooling Tower Institute

The Marley Company

MARLEY Kansas City, Missouri

*U. S. Patent No 2681179

Suppliers . . .

M.S. degree at the University of Louisville.

After serving for four years in the Army as a chemical supply officer, Matzner began his business career with Joseph E. Seagram & Sons where he handled a variety of engineering projects. He became assocaited with Girdler's Gas Process division in 1953 and was assigned to mechanical and process design work. In late 1956 he was transferred to the Catalyst department and now handles the sale of catalysts to engineering firms and their clients.

Matzner is a member of the American Institute of Chemical Engineers and the Philadelphia Catalysis Club.

LACLEDE-CHRISTY DIVISION, H. K. Porter Company, Inc. has appointed **William Gates** as sales representative. Gates will headquarter in Pittsburgh, and his territory includes western West Virginia and southeast Ohio. He was formerly sales representative for Frazier-Simplex, Inc., Washington, Pa. and previously was with Bethlehem Steel Co. at Johnstown, Pa.

FYR FYTER CO. has appointed **W. J. Spencer** assistant sales manager of the Pyrene-C-O-Two Division. Spencer will have headquarters in Newark and assist in the direction of the national sales force of Pyrene-C-O-Two, manufacturer of a complete line of fire protection equipment.

He has been with the company for 10 years and previously had been on the sales staff of A. Gross & Co. in Baltimore.

A veteran of four years in the Army mechanized cavalry during World War II, Spencer was born and educated in South Orange, N. J. He now resides in Colts Neck, N. J.

WOLVERINE TUBE, Division of Calumet & Hecla, Inc., has appointed **Howard J. Luetzow** technical sales representative in Chicago and surrounding areas.

Formerly technical office sales representative in Wolverine's general sales office, Detroit, Luetzow will contact petroleum, petro-chemical and chemical companies plus heat exchanger manufacturers and fabricators. He will headquarter in Wolverine's Evanston Office.

THE MILTON ROY CO., Philadelphia, has appointed **Alfred E. Mohan,** to their sales-engineering staff.

A graduate of Villanova University in 1954 with B.S. degree in Chemical Engineering, he served over two years in the U. S. Navy as a ship's engineering officer. Prior to military service, he was employed at the Frankford Arsenal in polymer research and development.

A member of the American Chemical Society, he is presently attending Temple University working toward an M.S. degree in industrial management.

ARMSTRONG CORK CO. has announced that **L. E. Cover,** manager of equipment insulation sales of the Insulation division, has retired after 41 years service with the company.

Cover will be succeeded by **R. L. Collister,** assistant manager of equipment insulation sales.

Cover, an authority in the equipment insulation field, graduated from Pennsylvania State University with a B. S. degree in chemistry in 1912. The Middletown,

Hoots Mon!

'tis a waste ta watch me goin' through the air—

'cause 'tis ADAMANT FIRE BRICK CEMENT that's really "AIR FLOATED" for *exceptional smooothness!*

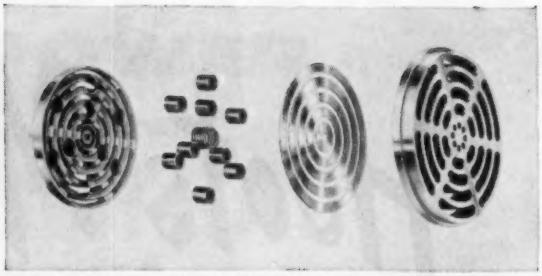
Specifically, our canny Scot is referring to one stage in the manufacture of ADAMANT, *the original high temperature cement*, when it passes through a process known as "Air Floating" . . . there, the larger, coarser particles are dropped out, leaving only the basis for a finer, smoother cement . . . this greater uniformity and *extra smoothness* makes possible the preferred thin joints . . . joints that really weld the brick together. "Aye, famous ADAMANT is literally *unbeatable* as a bonding agent . . . Money savin'," says Scotty.

Write for Bonding Mortars bulletin #3 . . . Yellow pages of 'phone directory have your nearest ADAMANT Distributor.

Botfield
FOUNDED 1907
REFRACTORIES
ADAMANT and other ADA products
swanson and clymer sts.
philadelphia 47, penna.

For more data on advertised products, use Readers' Service Cards, last page.

VOSS VALVES in your machine mean



LESS MAINTENANCE, FEWER SHUTDOWNS for your compressor. (air, gas, ammonia)

- up to 40% more valve area • minimum pressure loss • higher efficiency
- less power consumption • normal discharge temperature
- quiet, vibration-free • utmost safety • lower operating costs

VOSS VALVES are made to specification, machined from solid stock (not cast) — VALVES and PLATES are of heat-treated alloy or stainless steel; PLATES are machined, not stamped, and ground for precise close-tolerance fit; are dimensionally stable . . . ductile . . . resist fracture, high temperatures and corrosion . . . withstand fatigue. SPRINGS, of heavy rectangular sections and large diameters, add to dependability and safety.

Our detailed proposal will be sent without obligation. Send name, bore, stroke and speed of machine.

J. H. H. VOSS VALVES REG. U.S. PAT. OFF.

J. H. H. VOSS Co., Inc.
785 East 144th Street, New York 54, N. Y.

MANNING & LEWIS ENGINEERING CO.
28-42 OGDEN ST. NEWARK 4, N.J.
WORKING PRESS:- SHELL TUBES
UNIT NO. JOB NO.

HEAT EXCHANGE and PROCESS EQUIPMENT

THIS NAMEPLATE IS YOUR GUARANTEE OF QUALITY

- Condensers
- Evaporators
- Jacketed Kettles
- Ribbon Mixers
- Agitators
- Reactors
- Pressure Vessels
- Heat Exchangers
- Reboilers

M & L REBOILER
Material: Carbon Steel
O.D. (shell): 32½"
Length: 11' 3"
Design Pressure: 150 P.S.I.
Design Temperature: 300° F
Code: A.S.M.E.

M & L engineers, drawing upon many years experience, designed, engineered and fabricated above unit to meet all the exacting service requirements set down in the specifications.

The customer, a well known petrochemical company in Texas reports reboiler has worked very satisfactorily since it was installed years ago.

This is one more example why, at Manning & Lewis, we insist that: "Quality Comes First." Let us prove this to your satisfaction. Send for your copy of general bulletin 810, or better still, state all conditions of service for a prompt accurate proposal on the heat transfer equipment needed *now* in your plant.

Manning & Lewis *Engineering Company*
DESIGNERS & MANUFACTURERS OF QUALITY HEAT EXCHANGE EQUIPMENT
28-42 OGDEN STREET NEWARK 8, NEW JERSEY
M.L

Suppliers . . .

Pa., native joined the Armstrong Cork Co., in Pittsburgh in 1916.

He was in charge of Armstrong Laboratories at Pittsburgh before entering military service in 1917. He served with the U. S. Gas Defense Service and reached the rank of Major before being discharged in 1919.

Cover was placed in charge of production research and technical sales service for the insulation division when he returned from military service. In the early 1920's he organized the company's Argo Research Laboratories at Gloucester, N. J., and directed this activity until it was transferred to the Armstrong Research and Development group in 1930.

Collister, who will succeed Cover, is a native of Cleveland and a 1948 aeronautics engineering graduate of Purdue University. Before completing his studies at Purdue, Collister served 42 months in the Army Field Artillery.

Since joining the company in 1948, Collister has served in Insulation division sales offices in Cincinnati, Indianapolis, and Chicago. He returned to the general office in Lancaster in 1954 to serve as administrative assistant in equipment insulation sales. He was named assistant manager in 1954.

J. R. SIMPSON & CO., Chicago, exclusive representative for Conoflow Corp., in northern Illinois and northwestern Indiana, has added **George H. Freundlich** and **Richard G. Klitchman** to the organization as sales engineers.

Freundlich is an electrical engineering graduate of the University of Purdue. He has had experience in the instrument and controls field, having spent nearly ten years as a sales engineer for both a manufacturer and a representative, before associating with J. R. Simpson & Co., early this year.

Klitchman also received his electrical engineering degree from the University of Purdue. Before joining J. R. Simpson & Co., he was employed as a project engineer for a large instrument manufacturer, and as chief controls engineer for a consulting engineering firm.

H. K. PORTER CO., INC.'s Laclede-Christy, St. Louis, and **McLain Fire Brick,** Pittsburgh, have been combined under common management. To be known as the Refractories division, it also will bring under the one management the newly acquired Mullite Refractories, Shelton, Conn. The Refractories Division will be headed by **S. R. Gurley, Jr.,** as its vice president and general manager. **W. Alfred Turner,** former vice president and general manager of McLain Fire Brick, is now a vice president of H. K. Porter Co., Inc., and will act as advisor and consultant on refractory matters.

WESTON ELECTRICAL INSTRUMENT CORP. has appointed **Hubert B. Stallings** district manager of the Philadelphia territory. Weston is a subsidiary of Daystrom, Inc.

Prior to this appointment, Stallings was national sales manager, Electro-Magnetic Clutches, I-T-E Circuit Breaker Co., Philadelphia. An electrical and mechanical engineering graduate of Illinois Institute of Technology, he has had over 20 years experience in the sales and sales engineering of electrical and electronic components, as well as industrial instruments.

DU PONT

Better Things for Better Living ... through Chemistry

PETROLEUM ENGINEERING NEWS

LATEST PROPERTY AND APPLICATION DATA ON TEFLON® tetrafluoroethylene resin

Bearings of TEFLON® reduce friction, minimize wear, resist corrosion

Use of Du Pont TEFLON in the design of oil-field, refinery, and petrochemical equipment is increasing. In the Floco meter, a rotor is the only moving part actuated by the flow of oil. Owing to its unique combination of properties, Du Pont TEFLON is used as the thrust bearing and bearing seal for this rotor.

Because TEFLON tetrafluoroethylene resin has outstanding chemical inertness, it is unaffected by petroleum distillation products, catalysts and reagents. In fact, TEFLON is inert to nearly all chemicals and solvents in commercial use. The few exceptions to this include attack by the alkali metals under certain conditions. At high temperatures and pressures, halogens and certain halogenated chemicals may also affect TEFLON.

Bearings of TEFLON are "self-lubricating." When in use, a bearing actually coats the revolving shaft with a molecular film of TEFLON. Thus, any friction is that of TEFLON against TEFLON, which is no more than that of ice against ice. Shafts need not be mirror-finished, although finishes on the order of RMS-15 are recommended.

Use of TEFLON overcomes the effect of abrasive contaminants. Foreign particles which penetrate between bearing surfaces imbed themselves in the TEFLON. Thus, they are rendered harmless and do not score the shaft. TEFLON stays tough and flexible at sub-zero temperatures and is capable of continuous service even at 500°F. The water absorption of TEFLON is zero by ASTM test D570-42. It will not shrink, swell, crack or harden.

Du Pont TEFLON is now widely preferred as the material for bearings in chemical pumps conveying extremely corrosive liquids such as chromic acid. Seals, bearings, packings and other parts made of TEFLON operate reliably year after year. Components of TEFLON frequently eliminate costly and troublesome problems of maintenance.

FLOCO METER shown above is designed to meter crude oil accurately, with a minimum of attention and maintenance. Vital to trouble-free performance in this pump are bearing seals of TEFLON tetrafluoroethylene resin, which are unaffected by petroleum chemicals and suspended abrasives such as sand. Waxes in the oils do not adhere to the surface of TEFLON; clogging is prevented. (Manufactured by Flow Equipment Company, Inc., Los Angeles, California.)

TEFLON®
is a registered trademark...

TEFLON is the registered trademark for Du Pont tetrafluoroethylene resin, and should not be used as an adjective to describe any other product or any component part; nor may this registered trademark be used in whole, or in part, as a trade name for any other product.

SEND FOR INFORMATION

Mail this coupon for additional property and application data on Du Pont TEFLON tetrafluoroethylene resin.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept.
Room 364, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont TEFLON tetrafluoroethylene resin. I am interested in evaluating this material for _____

Name _____

Position _____ *Company* _____

Street _____

City _____ *State* _____

Type of Business _____

In Canada: Du Pont Company of Canada (1956) Limited, P. O. Box 660, Montreal, Quebec.

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Petroleum Refiner New Classified Rates

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* * * * * * * * * * * * * * * * *

HELP WANTED

■ PROCESS ENGINEER with two to five years' experience in refinery process work to fill position in newly organized Refining Division Technical Section. Work is of broad nature covering selection of processing steps and economic evaluation of processes. Unusual opportunity for advancement. Will pay moving and transportation expense. Liberal retirement, savings, insurance and health plans. Location—Bartlesville, Oklahoma. Replies will be held in confidence. Send resume of experience and salary requirements to Industrial Relations Division, Cities Service Oil Company, Bartlesville, Oklahoma.

■ MECHANICAL ENGINEER. For Major Oil Company in Mid-Continent area. Must be graduate engineer and have six to ten years supervisory and master planning experience in Refinery Mechanical and Maintenance Department. Address all replies giving age, education, resume of experience and salary expected to Box 260-R, c/o PETROLEUM REFINER, Houston 1, Texas.

REFINERY ENGINEER—Process engineering position with large independent company operating in Mid-Continent area. One to five years experience desired. State qualifications and give salary requirements. **Cooperative Refinery Association, Box 7305, Kansas City 16, Missouri.**

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Need Engineers - Technical Personnel? Try a Classified Ad in Petroleum REFINER.

QUICK! ECONOMICAL! RESULTFUL!

Help Wanted! Classified Ads in Petroleum REFINER get the job done.

HELP WANTED

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Established firm needs power engineer with E. E. Degree plus experience in transmission and distribution engineering. Outstanding potential for ambitious person interested in his development. Age to 45. Salary in $12,000 bracket.

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- *Design*
- *Instrumentation*
- *Development*

(Methods & Data)

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SOUTHERN CALIFORNIA

for men with experience in these fields for petroleum, petro-chemical, or chemical plants.

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Submit resume of training, experience, and work references to:

The FLUOR CORPORATION, LTD.
ENGINEERS — CONSTRUCTORS
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HELP WANTED

EHRHART & ASSOCIATES, INC.
Engineers and Constructors

Engineers

PROCESS • PROJECT MECHANICAL
for
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Men with 5 to 15 years experience in design and design supervision of process plants, refineries or chemical plants are required for small rapidly growing company with opportunities at senior levels. Company is engaged in engineering-construction projects for major West Coast Companies.

Company paid hospitalization, life insurance and vacations.

Personal interviews will be arranged.

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Heat Exchangers Pressure Vessels

Men with refinery or chemical plant experience who are familiar with process design and estimating of heat exchangers and fractionation columns. Responsible positions with an outstanding manufacturer. Good salaries. Profit-sharing retirement plan. Allowance for moving to Southern California. Send a summary of your experience and interests to F B Stratford, Head of Personnel, C F BRAUN & CO, Alhambra, California.

POSITIONS WANTED

■ ACCOUNTANT—Seven years Petroleum Cost experience, age 37, married, three children, B.S., Accounting, Minor Chemistry. Box No. 127-W, WORLD OIL, Houston, Texas.

■ CHEMICAL ENGINEER: Fifteen years experience process design, economics, project planning and coordination in petroleum and petrochemicals, desires responsible engineering position or technical sales requiring process background. Box No. 126-W, WORLD OIL, Houston, Texas.

HELP WANTED

PROCESS ENGINEERS

For work in Tulsa, Oklahoma. Minimum requirements: B.S. degree in chemical or refinery engineering. Three to six years' experience in Process Design work relating to Chemical Plant and/or Petroleum Refinery Engineering and Construction.

Salary commensurate with educational background and experience. Furnish complete resume of experience with initial letter. Contact Glenn O. Hopkins, Personnel Manager, P. O. Box 1558, Tulsa, Oklahoma.

The Refinery Engineering Co.

HELP WANTED

ENGINEERS
Come South

Major Oil Company has openings for Mechanical, Electrical, Chemical, and Civil Engineers in several phases of refinery engineering and process engineering, and for chemists in research and analytical. Locations near New Orleans; South Arkansas; near Williamsburg, Virginia; and near Galveston-Houston, in booming industrial areas where climates and natural advantages make living more enjoyable for all the family. Attractive salaries and benefit programs. 0-10 years' experience. In reply give age, education, experience, and salary expected.

Director of Industrial Relations
AMERICAN OIL COMPANY
P. O. Box 401
Texas City, Texas

HELP WANTED

ENGINEERS
Process

Assignments in our Process Engineering Department for engineers with three to six years experience range from integrated refineries and chemical plants through all types of individual process units. The work includes heat and material balance, and computations for unit operations such as fractionation and heat-transfer. Send a summary of your experience and interests to F B Stratford, Head of Personnel, C F BRAUN & CO, Alhambra, California.

HELP WANTED

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SCIENTISTS AND ENGINEERS—for Operations Research projects throughout the Jersey Standard interests. These involve the study of terminal operations, transportation, and inventory control problems. Such studies typically mean one or more field trips to collect basic data and to define the problem; analysis of the data to develop "mathematical models" of the problem; close work with the client to incorporate the results of these studies, and finally, follow up on the results.

Give full details of education, experience, desired salary, availability date and references. All inquiries will be considered promptly and held confidential.

Esso Research and Engineering Company

(Chief Technical Subsidiary—Standard Oil Company (New Jersey))

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Employee Relations-C
P. O. BOX 51 **LINDEN, N. J.**

CHEMICAL AND MECHANICAL ENGINEERS

A large and expanding international petroleum company has openings for several Chemical and Mechanical Engineers with outstanding ability. This is a challenging opportunity to share the responsibility of coordinating international refining operations. Excellent advancement opportunities for applicants with a minimum of 3 years petroleum or chemical industry experience. Immediate assignment to our Far East refineries or to our White Plains Headquarters with an eventual overseas assignment. Salary commensurate with experience, liberal annuity, insurance, hospitalization and savings plans. Will pay moving and transportation expense. Please send background and experience resume to:

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STANDARD-VACUUM OIL COMPANY
P. O. BOX 1000
WHITE PLAINS, N. Y.

More Classified Advertising on Next Page

CLASSIFIED ADS

HELP WANTED

ENGINEERS

Process

Assignments in our Process Engineering Department for engineers with eight or more years of experience cover process design, selection of processing steps, and economic evaluation of processes. Other work may include market analysis, industrial surveys, and technical assistance to sales. Send a summary of your experience and interests to F B Stratford, Head of Personnel, C F BRAUN & CO, Alhambra, California.

HELP WANTED

DESIGNERS

Piping

Assignments in our Piping Engineering Department for designers with three or more years experience range from integrated refineries and chemical plants through all types of individual process units. Assignments include arrangement of plant equipment and facilities, layout of process and utilities piping. Send a summary of your experience and interests to F B Stratford, Head of Personnel, C F BRAUN & CO, Alhambra, California.

HELP WANTED

ENGINEERS

Chemical
Mechanical
Petroleum

Assignments in our Chemical Engineering Department cover application of processes to a wide variety of industrial plants, complete integrated refineries and chemical processing centers. The work includes coordinating of chemical engineering, selection and design of process equipment and startup of completed plants. Send a summary of your experience and interests to F B Stratford, Head of Personnel, C F BRAUN & CO, Alhambra, California.

ESSO EXPANSION PROGRAM

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IN

COST ENGINEERING

Career positions available for graduate engineers in long range expansion program. Work involves technical aspects of cost estimating, development of estimating methods and cost analysis for all types of petroleum and chemical processing plants.

Excellent opportunities to learn many aspects of process and mechanical design while contributing to selection of optimum equipment for world wide expansion program.

High scholastic rating and ability to grow with organization particularly desired. Prefer one to five years engineering experience. Salary commensurate with experience and qualifications.

All inquiries will be considered promptly and held confidential.

Letter should give full details of education, experience, salary desired, availability date and references.

ESSO RESEARCH AND ENGINEERING COMPANY

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CHEMICAL ENGINEER

An expanding program in the new and extensive facilities at Parma, Ohio, requires a chemist or chemical engineer with training or experience in petroleum refining or coal hydrogenalysis procedures for research and engineering in the field of utilization heavy residues.

As the newest of several major research centers of Union Carbide and Carbon Corporation, the Laboratories at Parma also offer excellent opportunities for research in Solid State Physics, Electrochemistry, and High Temperature Chemistry, Carbon and Graphite.

Mail resume and college transcripts to:

G. H. Murray, Jr.
Personnel Director
National Carbon Research Laboratories
P. O. Box 6116
Cleveland 1, Ohio

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NEW EXPANSION JOINT DESIGN

from the world's most experienced manufacturer

- ✓ **Up to 50% Less Weight...**
- ✓ **Longer Cyclic Life...**
- ✓ **Better Equalization**

Series 150 S-R Double Joint, flanged ends, cover removed from one bellows

Intensive research program pays off in revolutionary design of Badger S-R Expansion Joints

BADGER S-R Packless Corrugated Expansion Joints — an entirely new design — are now ready for your most exacting power, heating, industrial and process piping applications.

Two significant features of Badger S-R Joints are 1.) Curvilinear Corrugations, which result in natural "all-curve" flexing and more equal distribution of movement among the corrugations; 2.) tubular Reinforcing Rings, which work with the new corrugations to produce greater effective flexing height and "all-curve" flexing even under higher pressures and temperatures.

And there are other important features, too . . . size for size, Badger S-R Joints weigh up to 50% less than conventional types . . . new ring design reduces joint diameter . . . a complete line of accessories — including covers and liners — are available . . . standard models in stainless, monel and inconel, special types in any workable alloy.

Write for illustrated brochure today!

Series 50 corrugation cross-section

Series 150 corrugation and ring cross-section

New corrugation and ring designs produce better equalization, "all-curve" flexing.

The radically different Curvilinear Corrugations used in Badger Series 50 S-R Expansion Joints were developed by the Badger Research Department. When under operating pressure (white line in cross-section above), the new design produces more uniform movement per corrugation and natural "all-curve" flexing. These features result in lower stresses and therefore increased life.

Series 150 S-R Joints also feature Curvilinear Corrugations and, because they are used at higher pressures, have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation yet allow natural "all-curve" flexing (white line). The tubular shape of the rings also permits greater effective flexing height and therefore contributes to longer joint life.

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EXPANSION JOINTS

BADGER MANUFACTURING COMPANY • *230 Bent St., Cambridge 41, Mass. • 60 East 42nd Street, N. Y., N. Y.*

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What's New in Equipment . . .

. . . and Manufacturers Literature

1 This is the array of equipment required to make a bell and spigot joint in an alloy cast iron drainage line.

2 Only a can of cement and brush are needed to join PVC pipe and a PVC socket type drainage fitting.

New Plastic Piping Reduces Costs

Spent acids and other liquid wastes of industry are being drawn off more economically in polyvinyl chloride piping, it is reported. Changes in direction are made with socket type solvent welding drainage fittings now developed.

The PVC piping is replacing cast iron and ceramic lines, which employ conventional bell and spigot fittings, where corrosive solutions are conveyed at low pressures.

Sizes of the new PVC* drainage fittings range from 1½ inches through 4 inches. They match Schedule 40 PVC pipe of corresponding dimensions and are available in the form of elbows, T's, Y's and other standard branch connections.

Carl B. McLaughlin, executive vice president said, **"PVC pipe costs less.** A 4-foot length of Schedule 40 alloy cast iron pipe in the 2-inch size, for example, sells for about $14.50. A 4-foot length of Schedule 40 PVC pipe in the 2-inch size, on the other hand, is priced at approximately $3.74.

"Most PVC fittings cost less. A Schedule 40 alloy cast iron "Y" in the 2-inch size, to cite an instance, runs about $6.50. This compares with the $5.30 price tag on a Schedule 40 PVC socket welding "Y" in the 2-inch size.

"Less labor per joint. Recently a journeyman plumber was timed as he made a bell and spigot joint in a 2-inch Schedule 40 alloy cast iron line. It took him three minutes and 45 seconds. Then he was asked to join a length of 2-inch Schedule 40 PVC pipe to a PVC socket type drainage fitting. He was finished with the job in 56 seconds."

Fewer tools and materials are needed. It is estimated that the cost of materials used in making a bell and spigot joint in 2-inch Schedule 40 alloy cast iron pipe is approximately 70 cents. Only a can of cement and a brush are used to join 2-inch Schedule 40 PVC pipe and a PVC socket type fitting. About $0.036 worth of cement permanently seals the joint.

"Fewer joints are required. The Schedule 40 alloy cast iron pipe often employed in low pressure drainage installations comes in relatively short lengths, up to 5 feet in the 4-inch size, while most commercial sizes of Schedule 40 polyvinyl chloride pipe are readily available in 10 foot and 20 foot lengths. There is a sharp reduction in the number of joints required where medium and long distances must be traversed. In extensive installations the omission of unnecessary joints results in substantial savings.

"Unimpeded flow conditions are provided. Bell and spigot joints have pronounced internal crevices that entrap the solutions being drained off, and sometimes formidable and dangerous corrosion problems occur in the joint area. Flow is also hindered at the joints. In PVC lines that employ the new socket type drainage fitting the bore at the joints is smooth and sanitary. Not only is crevice corrosion

For more data on advertised products, use Readers' Service Cards, last page.

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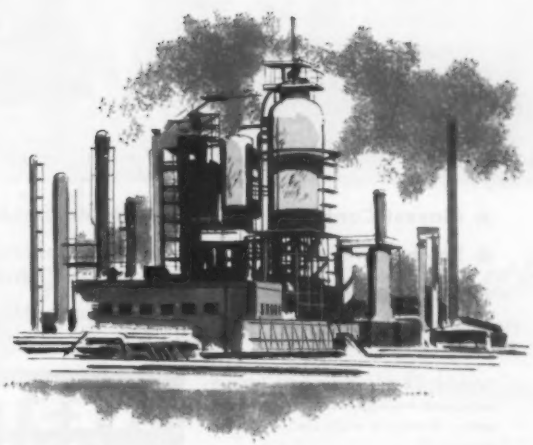
If you are considering new facilities in the oil, gas, chemical or allied industries, you can get valuable assistance from Fish Engineering Corporation and subsidiary companies. At Fish, you will find some of the finest economists, engineers and construction men in the world. They are ready to work with you every step of the way from feasibility studies through engineering, financing, construction and operation.



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A Valuable Reference for Maintenance Engineers and Original Equipment Designers

The most complete and helpful guide ever published by the originators of mechanical sealing for processing equipment—it illustrates and describes types of Dura Seals engineered to meet your specific temperature, pressure and fluid conditions.

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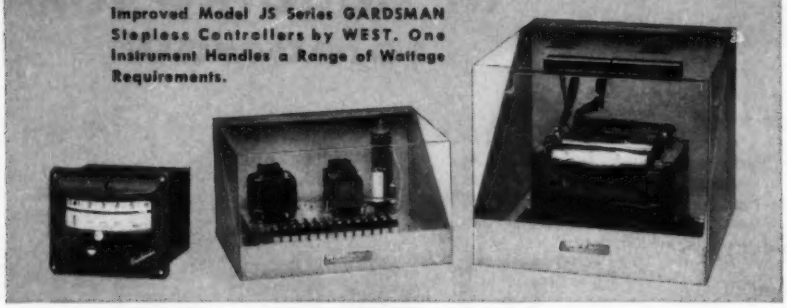
Stepless temperature Control

NOW! TUBELESS, MULTI-LOAD

Improved Model JS Series GARDSMAN Stepless Controllers by WEST. One Instrument Handles a Range of Wattage Requirements.



★ Closest Control
★ Save power
★ Prolong Heater Life
★ Adjustable Band
★ Manual Reset
★ Simplest Operation—One Knob
★ Least Maintenance

Without tubes or relays, this unique instrument *modulates* input to suit demand. Proved in wide use. Write for Bulletin JS.

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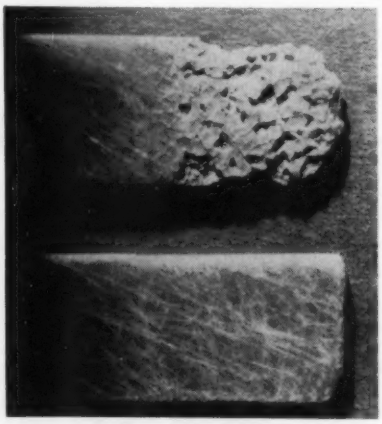
WEST Instrument CORPORATION
CHICAGO
SALES OFFICES IN PRINCIPAL CITIES

New Equipment . . .

avoided, but optimum flow conditions prevail as well." Tube Turn Plastics, Inc.

Circle E1, green card, last page.



Polyester Withstands Sodium Hydroxide Solution

These are samples of chemical and non-chemical resistant, glass-reinforced polyester. The characteristics of these compositions upon chemical exposeure are vividly illustrated.

Both samples have been boiled in ten percent sodium hydroxide for 48 hours. The non-chemical grade of polyester is almost completely decomposed in the exposed area, while the chemical resistant grade shows no change in appearance or properties. The chemical grade will stand exposure to boiling alkali for several months before serious degradation occurs.

The decomposition shown is characteristic of the type of failure which takes place in polyesters on exposure to all kinds of solutions containing water. Sodium hydroxide merely accelerates the degradation.

The chemical-resistant polyester is successfully utilized in the manufacture of corrosion-proof tanks, towers and accessories, hoods, stacks, tubing, sheets, and a variety of other equipment. Haveg Industries, Inc.

Circle E2, green card, last page.

Epoxy Coatings Provide Better Protection

Superior protection for surfaces and finishes exposed to corrosives and to adverse weather and atmosphere conditions is promised by two new coating resins.

Used outdoors and indoors, Maraset grey enamel 750 and clear varnish V-760 are flexible yet highly abrasion-resistant. They withstand a wide range of chemicals, including acids, alkalies, caustics, and solvents. Without softening or buckling even under high heat and extreme humidity, they adhere firmly to wood, metals, concrete, plaster, paper, and plastics.

Both the maintenance paint and the varnish have been successfully tested in the chemical and petroleum industry.

Maraset 750 enamel protects piping and equipment from the corrosive action of fumes, fluids, fuels, salt sprays, and spillage. In latex dipping, it smooths the

New Equipment . . .

finish of aluminum pattern duplicates and prevents development of pits and fissures from constantly repeated immersion.

Demonstrations have proved that the 750 enamel is unaffected by one month's immersion in toluene, gasoline, alcohol, salt water, carbon tetrachloride, 50 percent solution of acetic acid, 20 percent sodium hydroxide, 20 percent sulfuric acid, 30 percent nitric acid, and 40 percent hydrochloric acid.

The coatings are applied by standard brushing and spraying techniques. Working instructions embodying notes on mixing and on drying procedures, along with listings of specifications and properties, are summarized in technical bulletins issued by the company's laboratories. Marblette Corp.

Circle E3, green card, last page.

Miniature Pressure Gages Accurate to 0.5 Percent

A new air and hydraulic pressure gage has been designed that will operate from 0 to 5000 psi with an accuracy of 0.5 to 1.0 percent anywhere on the dial.

These gages are tested under the most severe conditions. They are cold tested at minus 100 F and heat tested at 300 F. They are heat calibrated at 150 F to an accuracy of within 0.1 percent.

The gages have no moving parts except the pointer. Rochester Manufacturing Co.

Circle E4, green card, last page.

New Valve Catalogue

A new, 80-page catalog on "Hancock" Bronze & Steel Valves has just been produced. Designs include globe, angle, gate, "Flocontrol" and other types applicable to power, petroleum, chemical and general industry installations. Engineering data such as material specifications, flow charts, temperature and pressure ratings, etc., are included in the catalog. Manning, Maxwell & Moore, Inc.

Circle E5, green card, last page.

Tubing Data Sheets

Engineers and others involved in the problems of corrosion and high temperature services will benefit from the technical data contained in ASL No. 285 and ASL No. 286 just issued. ASL No. 285 offers up-to-date data on B&W Croloy

New BRACKET AND LINKAGE for Butterfly Valves

Increases

Operator's Rangeability

Stability of Control

Reproduceability

Decreases

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Chatter • Friction

Power Requirement

Enables

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Standard parts — prompt delivery — maximum flexibility of application make mounting of operator at point of valve installation quick and easy. Made for valves to 48" size.

W. S. ROCKWELL COMPANY — 2367 Eliot Street, Fairfield, Connecticut

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

Quoth Sir Galvaknight: **Only Complete PROTECTION is Good Enough**

And the best *complete* anti-rust protection for iron and steel is hot-dip galvanizing. The hot-dip process seals out corrosion on *all* surfaces, as no other protective coating can. Armorplate your iron and steel with hot-dip galvanizing by the Southwest's largest commercial galvanizers, the Nowery J. Smith Company!

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one of the SMITH Engineered Systems in Southwest

For more data on advertised products, use Readers' Service Cards, last page.

...for straight right-angle cuts every time...the new

RIDGID

Wide-Roll Pipe Cutter

fast true pipe cuts on your power drive

Rolls are twice the usual width, double the bearing surface on pipe—sure straight start of cut . . . by hand or power drive—extra fast and easy. Pays you to see it before you buy your next cutter—at your Supply House.

No. 201, ⅛" to 1¼"
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The Ridge Tool Company, Elyria, Ohio, U.S.A.

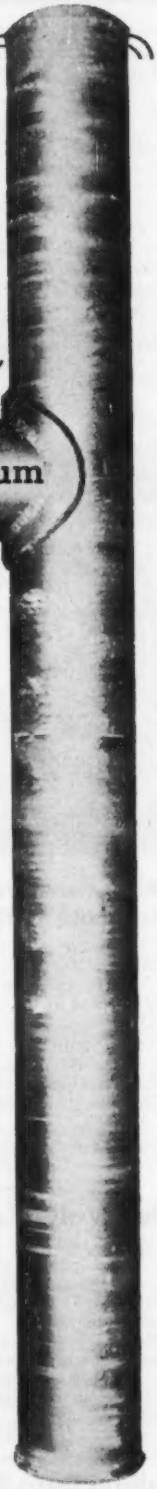
RIDGID
Work-Saver Pipe Tools

NO.2 in a series of ALUMICOAT APPLICATIONS

RESISTS HIGH TEMPERATURE CORROSION!

Alumicoat Molten Aluminum PROCESS

PROTECTS REFINERY EQUIPMENT



More and more refineries are discovering the advantages of the new ALUMICOAT Process! ALUMICOAT offers a firm resistance against corrosive media — *especially sulphur compounds* — and extreme temperatures!

In the ALUMICOAT Process, refinery parts are dipped in molten aluminum to produce a metallurgical iron-aluminum bond at the interface and a surface overlay of pure aluminum. At temperatures exceeding the melting point of aluminum, the aluminum on the surface diffuses. This diffused coating, together with the iron-aluminum bond, provides a refractory material that gives steel maximum protection against high temperature scaling.

The Alumicoat Process can solve your corrosion and oxidation problems. Send for full details today!

ARTHUR TICKLE ENGINEERING WORKS, INC.

26 Delevan Street MAin 5-4200 Brooklyn, N. Y.

27-4-1 (Type 329) in tubular form, and ASL No. 286 furnishes the same information on B&W Croloy 25-12 (Type 309S). The Babcock & Wilcox Co.

Circle E6, green card, last page.

Non-Electronic Generator Measures Pressure

In measuring pressure, differential pressure or flow, the signal transmitter (by means of a twisted Bourdon tube for pressure or bellows for differential pressure and flow) converts the process variable into a shaft rotation of the Electro-Syn, a rotary differential transformer. Output from the ElectroSyn Transmitter is an a-c voltage exactly proportional to the variable (12 volts full scale). This non-electronic signal generator system is used for the measurement, indication, transmission and control of a variety of process variables: pressure, differential pressure, flow, liquid level, temperature. High reliability combined with low maintenance and extreme flexibility are cited as the significant features which distinguish ElectroSyn from comparable existing systems. Norwood Controls.

Circle E7, green card, last page.

Slide Rule Computes Cooling Water Calculations

What make-up is required when recirculating 2000 gpm of water with a temperature drop of 10 F at 5 cycles?

The answer to this and many other questions are easily solved by the use of a slide rule that has been specially designed for cooling water calculations.

This slide rule will be sent free to those persons who are responsible for the control of scale, corrosion and algae in industrial cooling systems if they request one on their letterhead. Wright Chemical Corp.

Circle E8, green card, last page.

High Temperature Reprint

Engineers associated with the design and operation of high temperature equipment in processing plants will be interested in a reprint now available. The paper, "High-Temperature Problems in Process Plants," was originally given by John J. B. Rutherford, chief metallurgist of the division, at a short course on Corrosion Problems in the Process Industries presented by the University of California in cooperation with the NACE. The report discusses the use of steel and its various alloys, and the mechanical and physical reactions of the materials under various temperature and corrosive environments. The Babcock & Wilcox Co.

Circle E9, green card, last page.

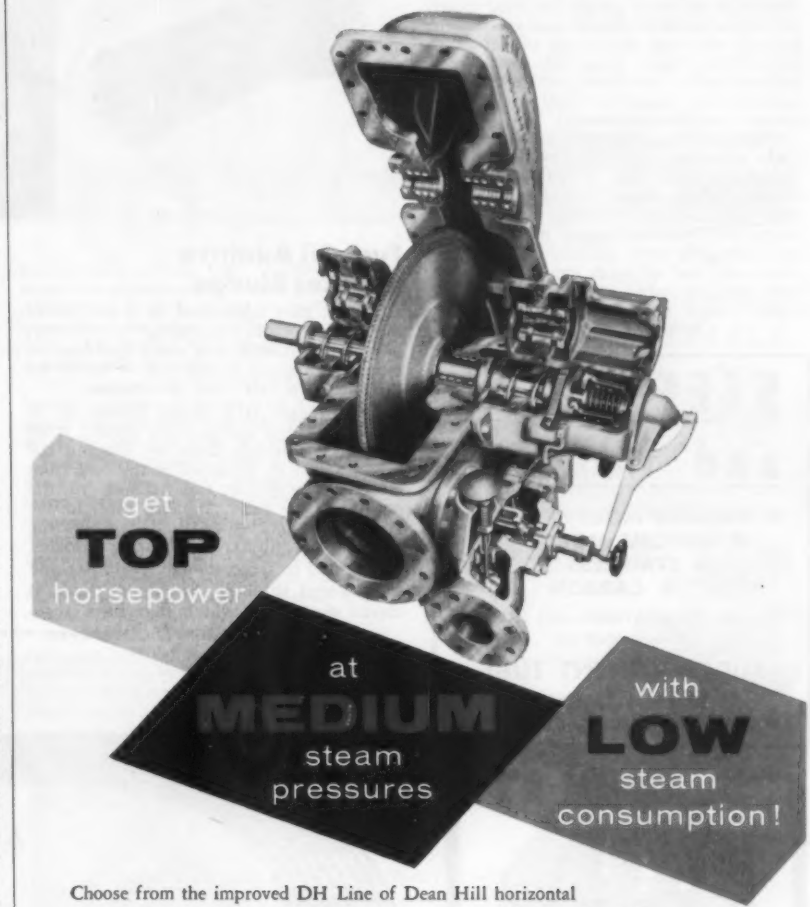
New Equipment . . .

Thermometer and Hydrometer

A new, 24-page booklet featuring the latest information on thermometers and hydrometers has been published.

The booklet contains a complete listing of ASTM, general and specific purpose thermometers and hydrometers for industrial and educational measurements of temperature and specific gravity. ASTM thermometers are listed by number and test.

Complete specifications are given, as



Choose from the improved DH Line of Dean Hill horizontal turbines which give you up to twice the power of earlier models while maintaining the same economy of operation.

The major change contributing to this tremendous power increase is the addition of steam nozzles to all models. On types now built with two nozzles—DH-10, DH-15, DH-20, DH-25—this change has meant *a 100% increase in the maximum horsepower of each unit!* On new three-nozzle models—DH-30, DH-35, DH-40, DH-45—the rated increase in maximum horsepower is 50%!

Why not get the complete power picture of Dean Hill's improved DH Line of horizontal turbines? Write today for Turbine Catalog, No. 500.

DEAN DH HILL PUMP COMPANY
Pump and Turbine Engineers Since 1893
Indianapolis 7, Indiana

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well as prices. Many items are illustrated.

The booklet also contains directions for reuniting mercury in thermometers, general facts about hydrometers and their use, suggestions for assuring accurate hydrometer readings, and other information. Central Scientific Company.

Circle E10, green card, last page.

New Line of Tank Fittings Reduces Evaporation

A new line of fittings, designed especially for storage tanks, is now being manufactured.

The application of precision as the outstanding characteristic of the line is well illustrated in their gauge hatches, which provide automatic closing and vapor-tight sealing, effecting a definite reduction in evaporation losses. These hatches have a resilient seal in the cover, which not only cushions the impact of closing, but also provides positive tightness.

Other new tank fittings announced include screened free vents, which provide unimpeded free flow of air and vapor; breather vents, which feature diaphragm seals for positive tightness; water drain valves, with steel bodies and resilient seats; and automatic tank gauges, which incorporate neg'ator spring in gauge head, with high visibility tape, and tubular float of a new design. A. H. Wheaton Co.

Circle E11, green card, last page.

STEEL PIPE and TUBING

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ALL SPECIFICATIONS – ANY SIZE

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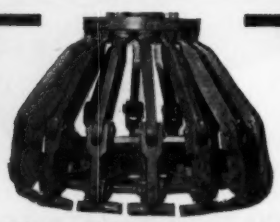

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Filling and Crimping Equipment

for handling greases and other viscous fluids.

- No operator required.
- 100% air operated.

Fills, seals, stamps and counts lug cover pails. Output of 15 pails per minute. Write for details on installation to meet your requirements.

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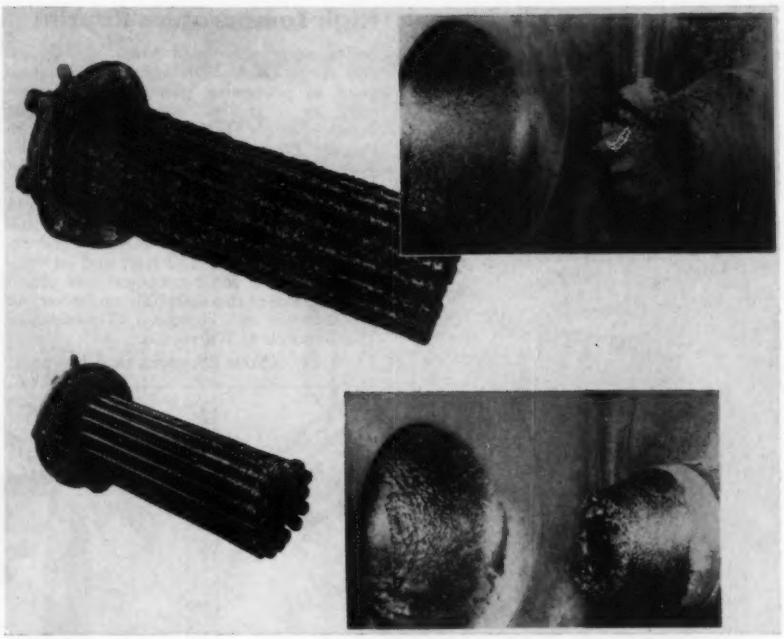


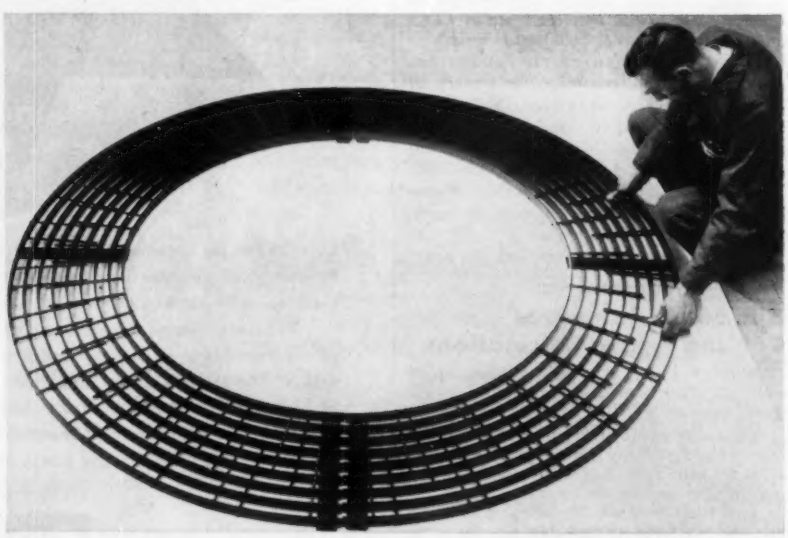
Fuel Oil Additive Reduces Sludge

Recent tests conducted in a number of industrial plants, including a refinery, have demonstrated that many problems in industrial heating plants, can be solved by the use of a new fuel oil additive.

The product is a sludge dispersant. It prevents sludge and gummy residue from forming in storage tanks by keeping the millions of tiny particles in the fuel from clustering together and settling to the bottom of the tank. Because the additive keeps the particles small, it prevents the clogging of filters and burner nozzles. When used in large enough quantities and recirculated through the storage tank, it cleans out sludge which may have accumulated, and continued use prevents new sludge from forming.

Visual evidence of the effectiveness of fuel oil additive No. 2 in industrial fuels is shown above. Upper left is a preheater used in most industrial burners and plants to make heavier fuels flow more freely. This preheater, almost completely covered with sludge, was taken from an installation before use of the additive. Lower left shows the same preheater re-installed without cleaning after use of the additive for six months. At upper right is a burner nozzle from an industrial heating plant after two days of operation with a competitive additive. Lower right is the same burner after nine days' operations with the additive. E. I. du Pont de Nemours & Co., Inc.

Circle E12, green card, last page.



Circular Walkway Flooring

The illustration shows a circular panel of open steel flooring, six feet six inches in diameter to the outside edge. This flooring has been produced to form circular walkways, providing a platform which is strong but light and safe under all weather

conditions. It also eliminates maintenance expense and is low in first cost.

This application is unique as it demonstrates how the flooring can be shaped without loss in material and labor. The old method of burning a square panel to form a circular shape with all its adherent wastages has been dispensed with. The circular panel is now fabricated in two half units from serrated edge steel rings spaced and held in position by forge-welded, twisted bars spanning six serrated rings in lattice pattern. This method of construction being carried out on top and bottom faces. Fisher and Ludlow, Ltd.

Circle E13, green card, last page.

Graphite Scrubber Removes Liquid Particles from Gases

A corrosion-resistant entrainment separator for the removal of liquid particles from air and other gases has now been developed. An impingement type entrainment separator made of impervious graphite, the type MV scrubber is a compact, self-contained unit ready for inserting in a pipe line.

Rods of impervious graphite, streamlined in cross-section, are staggered in rows within the cylinder. Although minimum clearance is one-fourth of an inch, which prevents clogging, a beam of light will not pass through. As the gas to be scrubbed flows through the cylinder, moisture particles impinge on the separator rods and the gas flows on through.

At a pressure of one atmosphere, the scrubber is designed for gas approach velocity of approximately 30 feet per second, at which the pressure drop is less than one inch (water column). The pressure drop is lower under vacuum conditions. At velocities twice those designed for, reentrainment occurs, but is retarded by the tear-drop cross-section of the separator rods.

The unit can be operated at temperatures ranging from 340 F. to minus 40 F., and at pressures from full vacuum to 65 psig.

It is available from stock in four internal cylinder diameters—6, 8, 12 and 16 inches. Each cylinder is 22 inches long, and is designed for installation between the faces of 150-pound ASA flanges with no enlargement of the pipe line.

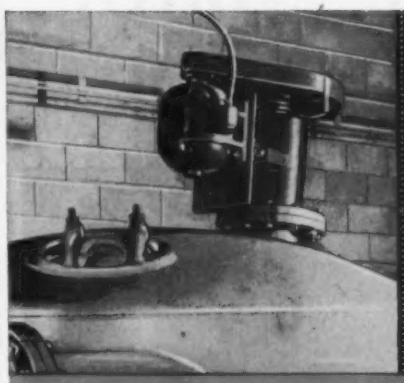
The internal separator rods are keyed in place without cement, thus permitting complete disassembly in minutes for cleaning. National Carbon Co.

Circle E14, green card, last page.

Measure Corrosion Directly

Instruments and techniques recently developed measure the rate of progress of corrosion on an exposed element of a probe by measuring the changes in electrical resistance as the cross-section is reduced.

The probe consists essentially of an exposed element which is part of an electrical circuit used to make resistance measurements on the element. The exposed element is made of whatever metal is of interest and can be used in three different forms: round wire, flat strip, or thin-wall tubing. The instrument determines the extent of corrosion on the exposed element of a probe by measuring



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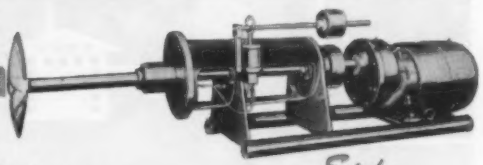

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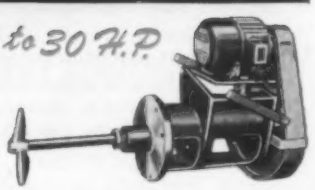

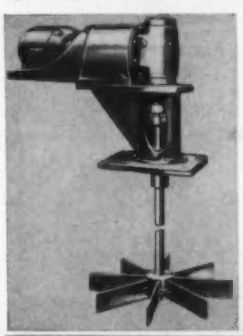

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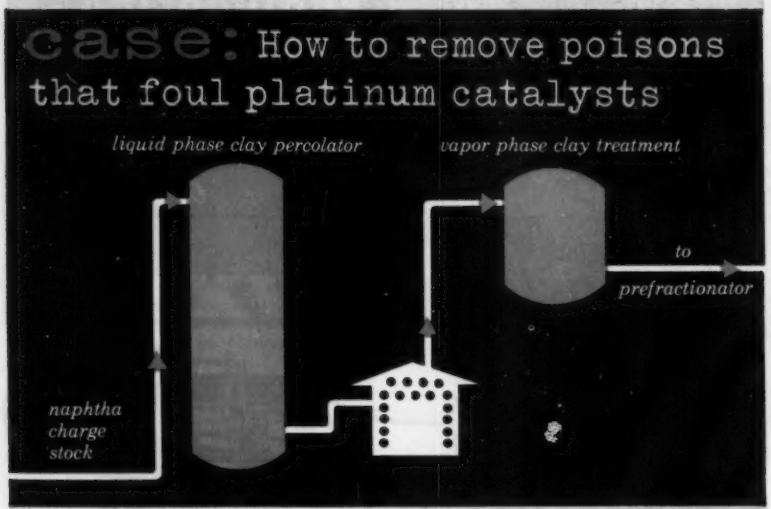

Attapulgus Clay will protect you against losses caused by platinum catalyst poisoning. It does this by selective adsorption and catalysis —direct removal of the harmful compounds from the reformer charge.

Attapulgite Adsorbent Report: Feed stock passes through Attapulgite Clay-packed "guard case" equipment where troublemaking constituents are removed from the stream (some need only be present at *10 parts per billion* to temporarily—even permanently—foul the catalyst.) Poisons removed include: Arsenic—present in the crude or picked up along the way; Nitrogen—from crude or other sources (these by adsorption); Tetraethyl Lead—from refinery cross-contamination; Alkyl Sulfur compounds (these by catalysis).

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the changes in electrical resistance as the cross-section is reduced and gives readings directly in terms of micro-inches of corrosion.

Features of the instrument and method include: (1) Rapid and direct measurements requiring only 30 seconds; (2) Readings on probes taken as often as desired on the same probe; (3) No shutdown required to retrieve metal specimen, measurement being made while process is in operation; (4) Difficultly accessible places measured by extending cables from probe to convenient location; (5) Less time required to obtain complete information, the high sensitivity detecting loss of only a few microinches of metal; (6) Versatility of application permitting use in liquids, gases and semi-solids, and accumulation of corrosion products (oxides, sulfides, carbonates, scale, etc.) having no effect on measurements; (7) Quick, sure method of evaluating effects of corrosion inhibitors or changes in process variables. Crest Instrument Co.

Circle E15, green card, last page.

Meter Selection Bulletin—A newly revised 16-page edition of the ER industrial meter bulletin (OG-400) offers enough additional information on factors affecting meter selection to enable single-plant operators to be self-sufficient in ordering.

Included in the new bulletin—four pages longer than its predecessor—is more complete temperature, viscosity, pressure and registration data along with additional illustrations, an explanation of various metering terms and explicit ordering instructions.

The bulletin describes a complete line of oscillating piston meters, recommended for a variety of chemicals and industrial liquids. It offers more complete data on meter construction—explaining, with the aid of tables and charts, which case, piston and chamber are best suited for use with specific liquids. Rockwell Manufacturing Co. **Circle E16, green card, last page.**

Gas Dehydrator—Development of a new line of glycol type gas dehydrators with processing capacities ranging from 1.7 million to more than 60 million standard cubic feet of gas daily was recently announced.

The water absorbing capacity of the units is increased through action of the external glycol-gas heat exchanger which cools the glycol before contacting the gas stream.

The 42 dehydrators in the new line are designed to reduce water vapor content of natural gas to less than seven pounds per million standard cubic feet of gas or depress the water vapor dew point of the gas 65 degrees, whichever criterion is reached first.

Initial glycol charges for the dehydrators range from 35 gallons for the unit sized to process up to 1.7 million SCFD to 1750 gallons for the dehydrator designed to handle 61.8 million SCFD.

The absorber contains an efficient mist extractor which reduces glycol loss to a minimum and four bubble trays in standard units which insure efficient glycol-gas contacting.

Absorbed water is removed from the

glycol by a reconcentrator consisting of a glycol reboiler, storage tank, still column, heat exchanger and filter with by-pass and safety relief valves.

A new manual describing these dehydrators is now available. Delta Tank Manufacturing co., Inc.

Circle E17, green card, last page.

Cement-Mortar Coating Can Now Be Sprayed On

For many years the application of cement coatings to considerable thickness was possible only through trowelling or use of expensive and specialized equipment involving other spraying methods. On vertical and overhead surfaces the use of wire-lath was imperative in order to prevent the concrete mix from falling off.

A new formula of concrete mix which can be applied swiftly by spraygun and pressure pot to any desired thickness has been developed. All of the advantages of concrete over organic coatings, such as heat resistance, poor electrolytic conductivity, extreme hardness and relatively high resistance to salt water, frost and most alkalis and acids, are retained. Only a 65 cfm compressor is needed instead of the much heavier equipment commonly associated with the hydraulic cement application. Chemical Fire and Rust Proofing Corp.

Circle E18, green card, last page.

Teflon Hose Assemblies

In answer to industries urgent need for safe chemical resistant flexible hose units having superior physical properties to rubber or metallic types the company announces the "Lin-Lok" line of teflon hose assemblies.

The assembly consists of a teflon liner encased in stainless steel wire braid with specially engineered full flow fittings permanently locked to the hose.

The units are capable of sustained operating pressures up to 4000 psi at temperatures from minus 100 to 500 F and are recommended for use wherever maximum chemical resistance, freedom from contamination, wide temperature and pressure range, non-ageing, flexibility and ruggedness are prime requirements.

Eight sizes are currently available from stock ranging from 3/16-inch to 1 1/8-inch with a maximum length of 50 feet. Mic-Lin Co.

Circle E19, green card, last page.

Metal Spray Unit

A new metal spray unit of improved design for applying hard-facing alloys and other metals in powder form is now available. The new unit features improved metal flow rates and increased deposit efficiency with no sacrifice in quality of the sprayed deposit.

Designated the Model C-2 Spraywelder, the new model is designed for use in applying hard-facing powders to most types of steel (including stainless steel), cast iron and copper parts by the Spray-weld process. In this process, the powdered alloys are first applied by spraying and then are fusion-bonded to the part by heating with an oxy-acetylene flame.

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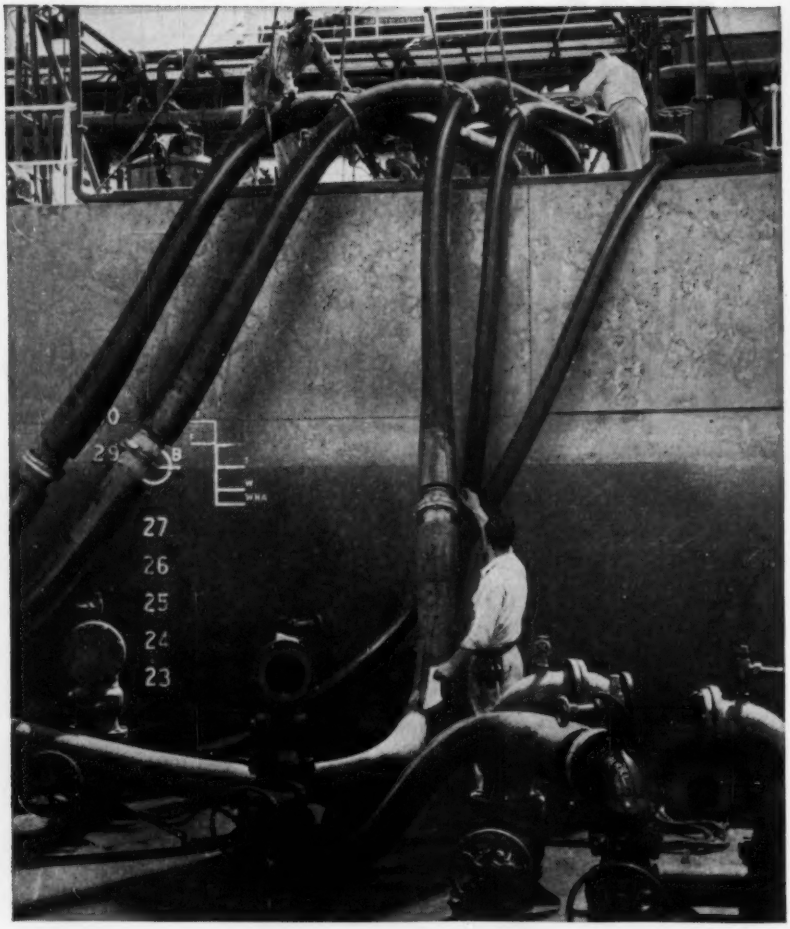

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New Equipment . . .

num, zinc, copper, nickel, stainless steel, brass, lead or high temperature brazing alloys in powder form can also be readily handled by the new unit.

Foremost among the improvements provided in the new spray unit is a redesigned carburetor and new spraying head design which contribute to higher metal spraying capacity and greater deposit efficiency. New material specifications for many of the head and carburetor components give longer life combined with improved performance. Wall Colmonoy Corp.

Circle E20, green card, last page.

New Polyvinyl Chloride Eductors

PVC Eductors are designed for use in liquid pumping and mixing operations, especially those employing corrosive fluids. They can also be used to handle solids when particle size permits. Polyvinyl chloride offers exceptional resistance against a great number of corrosive media, in many cases surpassing that of high grade steels and alloys. A few of the materials not to be handled are acetone, ketones, ethers, esters, or aromatic or chlorinated hydro-carbons.

The new line comprises six standard sizes, ranging from one-half inch to three inches, with performance characteristics similar to those of metal eductors of equivalent size. PVC Eductors have a maximum pressure rating of 125 psi and a maximum temperature rating of 160 F. Schutte & Koerting Co.

Circle E21, green card, last page.

High-Temperature Stopcock Grease

New silicone-base grease designed to resist leakage at elevated temperatures and prevent glass joints and stopcocks from freezing has the name Hi-Tem-Vac. Suitable for operation at temperatures up to 360 deg C and pressures as low as 0.5 mm Hg, the material is available in 2-ounce jars. Glass Engineering Laboratories.

Circle E22, green card, last page.

New Thermostatic Controller

A new pilot type thermostatic controller for higher temperature applications has just been developed.

The controller is available in standard temperature ranges of 250 to 450 F, and 350 to 550 F. However, the company said it can supply any 200 degree range from 50 to 600 F. The controller measures $3\frac{13}{16}$-inches in width and $19\frac{3}{4}$-inches in length, and is recommended where compressed air is used as the pilot supply.

The thermosensitive tube is made of stainless steel to withstand corrosion as well as temperature and erosion. A finned "thermal isolator" section keeps the pilot valve, adjustments, etc., cool on the high-temperature control applications.

FulTrol pilot controllers are installed at the location where temperature is to be maintained. The instrument's highly sensitive rod-and-tube thermal element is

New Equipment . . .

immersed directly into the medium being controlled. Because of its unusual construction, the controller may be installed in any horizontal or vertical position.

Any change in temperature at the thermal element activates a small pilot valve, which in turn varies the pressure applied to a control valve or other final regulating device. The pilots are modulating in action. Operation of the final control device governs the amount of either cooling or heating applied to the medium under control.

Systems utilizing the pilots have demonstrated great flexibility and are capable of doing jobs not practical with self-operated temperature regulators alone, the company said.

The "proportional band" or effective control differential of the new device may be adjusted quickly in the field to any spread between 5 and 25 F. with an ordinary screw driver.

The simple "straight through" action of the thermal element to pilot valve eliminates need for critical and troublesome levers and pivots, and makes possible easy disassembly and reassembly if cleaning or service becomes necessary. Robertshaw-Fulton Controls Co.

Circle E23, green card, last page.

Mist Eliminator Manual

Prepared especially for process engineers and designers a new manual is concisely written and clearly illustrated to show the design, application and performance of "Schuylernit" mist eliminators in chemical and petroleum process vessels.

The most complete and informative manual available, it explains and solves many liquid entrainment problems in scrubbers, absorbers, evaporators, knock-out drums, cracking towers and distillation equipment. The Schuyler Manufacturing Corp.

Circle E24, green card, last page.

Metal Hose and Tubing

A 60-page catalog on flexible metal hose and tubing has been published. The catalog has a complete specification covering all types of flexible metal hoses and fittings, and includes the various metals of construction and properties of each.

In addition it gives a special guide to use when specifying flexible metal hose and tubing. The American Brass Co.

Circle E25, green card, last page.

Guide for Welding Stainless Steels

—The selection of the proper electrode for most welding operations on stainless steels is made easy by the use of this new 4-page guide. Listed are 23 stainless electrode types, their chemical analyses and physical properties, and data concerning the application of these electrodes to most welding situations. A comprehensive chart of current ranges for stainless welding is also

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Circle E26 green card, last page

Electrode Data Book

A new 24-page Electrode Data Book has just been prepared. Included in the data presented in easy-to-use form are: information on AWS-ASTM arc welding electrode specifications; how to estimate electrode consumption; summary of welding symbols; factors in selecting electrodes and other data of interest to users of arc welding. National Cylinder Gas Co.

Circle E27, green card, last page.

Plastic-Enclosed Thermostat

Brochure describes two types of Thermoswitch units which are encased in plastic for service in highly humid or corrosive environments. These encapsulated thermostats can be immersed directly in acid or basic solutions, alcohols and aliphatic hydrocarbons, buried in soil for greenhouse or outdoor heater cable applications, and exposed highly humid atmospheres, corrosive mists, sprays, etc.

Two types of Thermoswitch controls are offered: the standard cartridge-type and a lower cost rectangular model. Both types are available with adjusting knobs for resetting the temperature in the field, or can be supplied factory-set at the control temperature. Current ratings up to 5 amps, 230 volts AC are available. Fenwal, Inc. **Circle E28, green card, last page.**

'Dinosaur' Saves Manpower

Dubbed the "Dinosaur" by cracking plant operators, the catalyst loading elevator shown here was built for C. F. Braun & Co. to be used by the Tidewater Oil Co.'s cracking plant in Delaware.

The "Dinosaur" is a mobile unit with telescoping boom which can be extended when in vertical position to a full height of 70 feet. The boom can be stowed in horizontal position and the entire unit moved easily and conveniently from station to station.

Catalyst material is fed by means of a barrel dumping device to a vibrating screen which may perform a scalping operation. The screen feeds to a zipper conveyor belt which elevates the catalyst to a head pulley at the top of the boom. It is then discharged into the reactor. Discharge heights on the boom are adjustable from 45 to 70 feet in 5-foot increments.

The elevator will deliver catalyst at a rate of 15 to 30 TPH depending on cubic foot density. This rate is based on a belt speed of 150 FPM. Capacity could be stepped up by 33 percent by increasing belt speed to 200 FPM.

Due to the extended design of the discharge head, the boom may be moved into close proximity to structure walls and overhangings.

The barrel dumper will complete a cycle every 45 seconds for a capacity of 80 barrels per hour. If desired, pallets of bagged material may be lifted by fork truck to the working platform for manual dumping.

With the "Dinosaur" no materials need be handled manually above grade level. With it, two or three men may do the work formerly requiring eight men. The conveyor will readily serve the requirements of new cracking installations which have not been provided with material handling facilities or will replace outmoded systems. High mobility of the "Dinosaur" shows to advantage where the cracking plant operator has a number of points to service. It also eliminates the major problem posed by stationary charging equipment which is normally idle a great part of the time. Stephens-Adams Manufacturing Co.

Circle E29, green card, last page.

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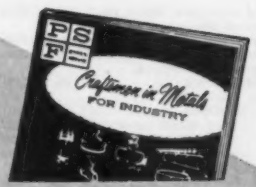

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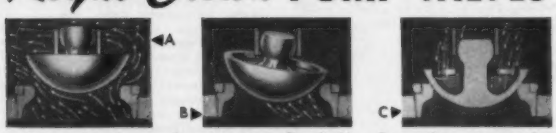

(A) Round valve surface is streamlined. No obstructions to restrict the flow. (B) Ball-guided valve rotates and swings with each stroke of the pump. Each turn, each swing ... a lapping action, a continuing perfect seat. (C) Free vertical action assures instant opening and closing. Ball stem is a frictionless guide.

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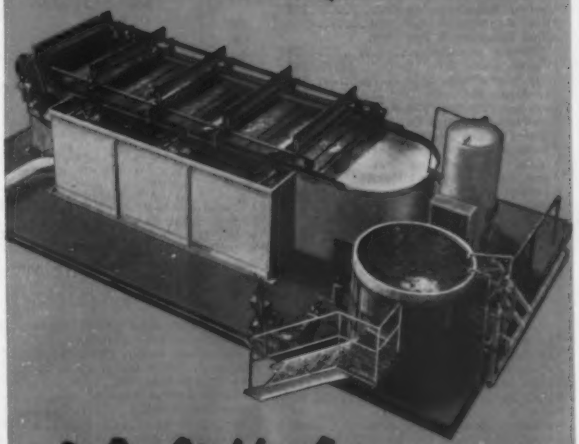

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If you have a pollution or waste recovery problem, a Bulkley, Dunton engineer will be happy to survey your needs and make recommendations. Bulkley, Dunton can also supply a pilot plant for on-the-job tests on your waste flow, if required.

Write today for complete information on Bulkley, Dunton Colloidair Separators or a survey of your disposal problem.

6-248

Bulkley, Dunton Processes, Inc.

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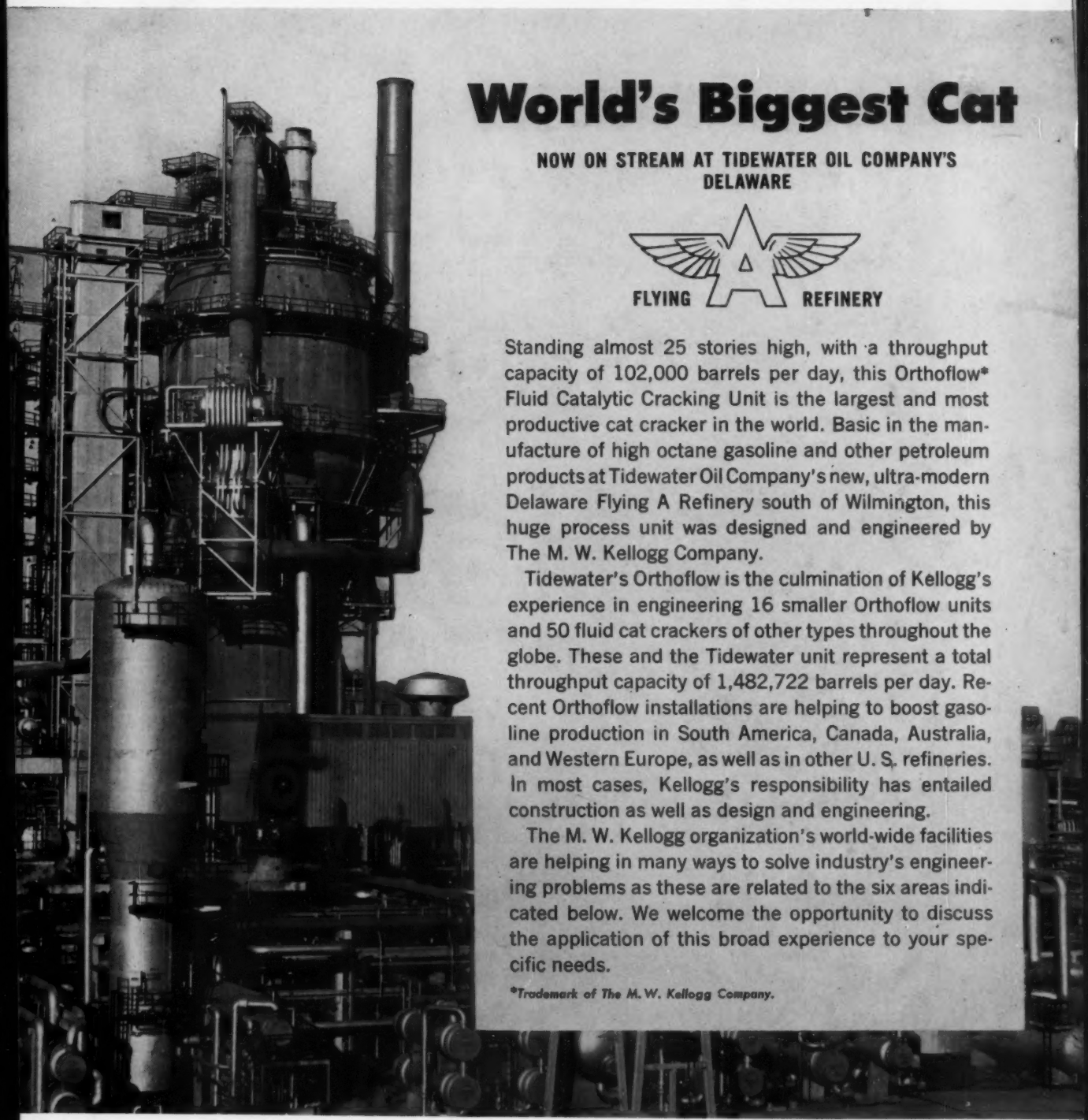

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